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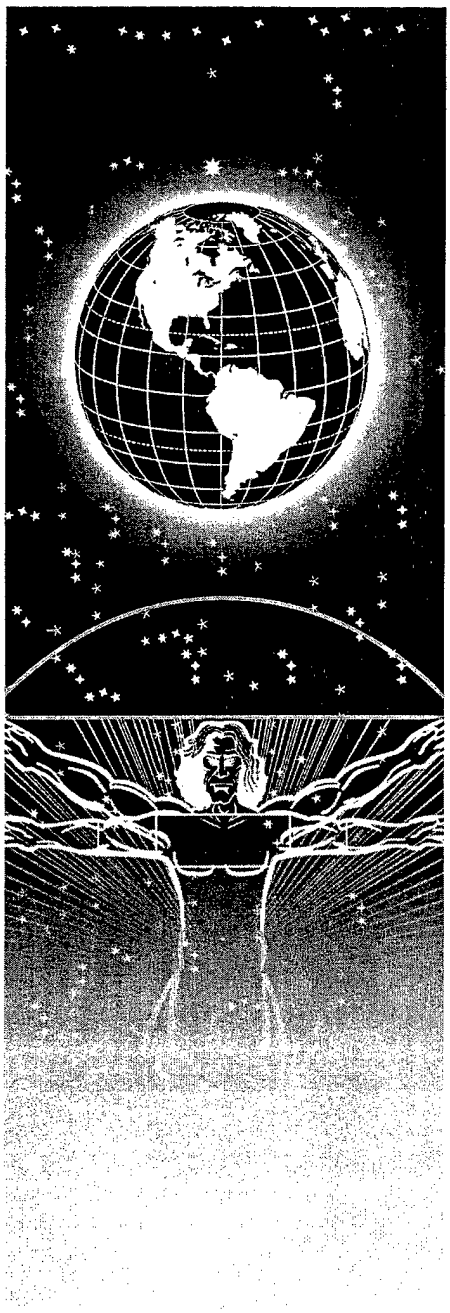

UNITED STATES AIR FORCE RESEARCH LABORATORY

COLLABORATIVE ELECTRONIC ENVIRONMENTS IN AN ACADEMIC AND TRAINING CURRICULUM

Lynne Schrum
Mary Ann Fitzgerald
Lara Luetkehans

Georgia Tech Research Corporation
859 Spring Street
Atlanta, GA 30332-0416

August 2001

AIR FORCE RESEARCH LABORATORY
HUMAN EFFECTIVENESS DIRECTORATE
WARFIGHTER TRAINING RESEARCH DIVISION
6030 South Kent Street
Mesa AZ 85212-6061

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WINSTON R. BENNETT, JR.
Project Scientist

DEE H. ANDREWS
Technical Director

JERALD L. STRAW, Colonel, USAF
Chief, Warfighter Training Research Division

Direct requests for copies of this report to:

Defense Technical Information Center
8725 John J. Kingman Road, Suite 0944
Ft. Belvoir, Virginia 22060-6218
http://stinet.dtic.mil

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Mary Ann Fitzgerald
Leutkehans, Lara

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14. ABSTRACT

The purpose of this effort was to investigate the uses and implementation of technologies and learning in ways that might prove useful for future applications for the United States Air Force, e.g., in distributing and updating skills in preparing military officers to assume leadership roles in the next century. This research sought to explore these issues using the US Air Force Academy (USAFA) with a cohort of students and faculty as a testbed. Researchers explored the uses of information technologies as they existed and examined their impact as they were systematically and thoughtfully introduced to USAFA cadets and faculty. Throughout the effort, the researchers investigated appropriate and significant uses of these technologies for collaboration, investigation, and academic research. Results suggest positive outcomes for content learning and some strong suggestions for improving the structure and process of this type of activity. Further research is needed to provide more information regarding best practices in using groupware for content-specific learning, collaborative problem solving, and group processes.

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PREFACE

This research was conducted under Workunit 1123-A1-26, Assessment and Evaluation of Information Technology, for the Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Training Research Division (AFRL/HEA), formerly known as Armstrong Laboratory. This research was performed under USAF Contract No. F41624-95-C-5025 with Georgia Technology Research Corporation. The Laboratory Contract Monitor (LCM) completing this effort was Dr Winston Bennett, Jr., AFRL/HEA; however, the original LCM was Dr Ted Lamb.

Documentation of this research was delayed due to personnel reassignments and the reorganization of Armstrong Laboratory at Brooks AFB TX. The final editorial and administrative work necessary to publish this report was accomplished at the Air Force Research Laboratory, Warfighter Training Research Division at Mesa AZ.

1.0 Introduction

The United States Air Force Academy (USAFA) has the responsibility for preparing military officers to assume leadership roles in the next century. The USAFA Educational Outcomes (USAFA, 1994) state that officers must possess a "breadth of integrated, fundamental knowledge" and describes graduates as having "an awareness of the technological, social, political, and economic complexities of *international as well as domestic issues.*" It is essential, in a world that is organized and structured by information, that these future leaders know how to find, evaluate, and use information, and to collaboratively turn that information into knowledge.

The purpose of our initial proposal was to investigate the uses and implementation of information technologies for teaching and learning in ways that might prove useful for future applications for the United States Air Force, for example, in distributing training and updating skills. This research sought to explore these issues using the USAF Academy, with a cohort of students and faculty, as a test bed. The goals and objectives of the project evolved over time, specifically in response to the dynamic and evolutionary nature of the technology, and the rapid development, expansion of, and access to, the World Wide Web during the life of this contract.

In conjunction with the resident representative of the Armstrong Laboratory and staff from the Center for Educational *Excel*lence at the United States Air Force Academy, specific research activities were determined to address the original guiding questions. Dr. Lynne Schrum conducted the research, with assistance from Dr. Kent Gustafson and doctoral students from the University of Georgia.

During the first year the researchers explored the uses of information technologies as they currently exist and examined their impact as they were systematically and thoughtfully introduced to cadets and faculty. Throughout the second year the researchers investigated appropriate and significant uses of these technologies for collaboration, investigation, and academic research. The research team compiled monthly interim reports. This summative technical report will serve as a vehicle to disseminate our experiences and results.

2.0 Orientation to the Issues

> Global networks are the electronic highways of world commerce, culture, credit, scientific research, and literary productivity. ... They are essential to our economic, social, and political survival. (Branscomb, 1993, p. 102)

Telecommunication networks, fiber optic communications, and distance learning facilities are changing the nature of teaching, learning, and work in all parts of our world. The information age, as experienced through the Superhighway, the Internet, or the Matrix, has arrived. Although military officers will be expected to possess and use the information and communication skills necessary to move into the 21st century, few have had the opportunities and experiences necessary to acquire these skills.

Cadets at the United States Air Force Academy require planned experiences to gain skills in using the information technologies within content specific areas, but also as general tools worthy of learning for their own value. Communications and research skills are generalizable to professional and personal challenges throughout their lifetimes. This does not happen by itself, and in order to prepare our future military leaders, significant and ongoing efforts must be made to investigate the most appropriate uses of these communication tools, particularly within the unique culture of the military.

To see the implications of this, one need only look to the United States Air Force Academy Educational Outcomes statement, as adopted in April, 1994. This

document states that graduates are to be "Officers who can communicate effectively, ...work effectively with others, and ...frame and resolve ill-defined problems" (USAFA, 1994). In several studies, the use of information technologies has been demonstrated to increase student abilities to communicate in oral and written work, to collaborate, and to cooperatively solve problems (Harasim, 1990; Kaye, 1987; Kerr & Hiltz, 1982; Levinson, 1990; Schrum, 1993; Sproull & Kiesler, 1991; Zuboff, 1988). Perhaps more importantly for the USAFA, these research experiments were conducted in traditional, non-military settings, which encourage collaboration. The culture of the USAFA, while built on the concept of team activity, still tends to encourage independent learning. This clash of established values with new goals and current trends represents a matter for informed policy analysis.

The research for this project was designed to investigate the uses and implementation of information technologies for teaching and learning, and explore the issues inherent in the development of a new educational paradigm that is based on access to world-wide resources and collaborative communications. During the first year the researchers focused on exploring the uses of information technologies as they currently exist, and examined their impact as they were systematically and thoughtfully introduced to cadets and faculty. It quickly became clear that it was necessary to investigate the uses and potential of groupware, a class of software that is designed to support and augment group work. Throughout the second year, the research looked carefully at appropriate and significant uses of these technologies for collaboration, investigation, and academic research.

2.1 Global perspectives

It is essential to place this research proposal in the context of current and future realities; most importantly the world now operates as an information society, which requires new knowledge, skills, and experiences. It has been said that "The people and the nation that don't learn to participate in an information-based society will be its peasants" (Cleveland, 1986, p. 62). Effective military leaders for the next century will be required to understand and effectively use computer mediated communications, including accessing information regardless of where it resides or its form, and to understand the implications of social, educational, and personal interaction that occurs electronically.

The military has long sought efficient and effective ways in which to deliver training to personnel, update skills, and inform rapidly. Distance learning has been shown an appropriate manner for some activities, and has the added potential of reducing travel expenditures (Barry & Runyan, 1995; Bramble & Martin, 1995). In addition, these future leaders will be asked to make decisions about many global issues in terms of international telecommunications. Questions of jurisdiction over global information networks will require new perspectives and informed decisions. Branscomb described the current and future situation, in which traditional boundaries of nation-states come in conflict with the transnational electronic communities that technology has created. In Branscomb's words, "This extra-territoriality within computer networks is terra incognita with no known territorial boundaries" (1993, p. 85).

2.2 Program objectives

The purpose of this research was to investigate, analyze, and evaluate the uses of information technology to inform decision makers regarding needed additions to infrastructure and modification of curricular activity, with a goal to create leaders who are information literate and knowledge producers. This research was carried out within the context of a testbed situation, at the USAFA, and in collaboration with the Center for Educational *Excel*lence at USAFA and the Armstrong Laboratory.

From the literature and experience, and from a beginning understanding of the unique characteristics and goals of the USAFA, the following research questions emerged as the project began:

- How do cadets and faculty use the emerging forms of information technologies?
- What impact do these technologies have on independent and collaborative work?
- When is it most effective to use synchronous versus asynchronous communications?
- What models of electronic learning are most effective to accomplish specific tasks?
- What obstacles (hardware, software, attitudinal, or situational) exist that interfere with individuals learning about and using information technologies?
- What pedagogical, organizational, and institutional issues must be considered in constructing online learning environments?

3.0 Activity Summary

The research project was divided into eleven tasks and organized in a manner to allow for investigation of each of the tasks individually, but to also encourage the organization and reflection of all the tasks as a whole. This provided a vehicle to discover the ways in which those tasks were interrelated and informed each other. The specific tasks with which we began this project were:

> **Task 1.** Collect baseline data on current uses of information technologies for instruction, research, and collaboration. Determine the extent of resources on campus and available remotely. Interact with the Armstrong Laboratory representative at the USAFA and personnel at the Center for Educational *Excel*lence regarding specific research designs, appropriate integration techniques, and choice of subjects.
>
> **Task 2.** Collect qualitative data on individual and group interactions, reactions to information technologies and collaboration, and information regarding backgrounds of uses.
>
> **Task 3.** Evaluate "groupware" software, which allows real time interaction, collaborative problem solving, and participatory writing. Determine appropriate software for the Center for Educational *Excel*lence to introduce.
>
> **Task 4.** Assist the Center for Educational *Excel*lence to design and create materials and workshops to teach uses of information technologies to a cohort of students and educators, using all three types of networks.
>
> **Task 5.** Using materials and tutorials, participants identified in Year One will be trained to use the existing networks, and the groupware. Research personnel will assist Center for Educational *Excel*lence in adapting their materials to incorporate and model information technologies.
>
> **Task 6.** As participants begin to use information technologies for research and problem solving, research personnel will use qualitative and quantitative methods to identify the types of activities completed, the nature of the collaborative work, the organizational structure of the groups that form electronically, and describe the observable impact of the technology.
>
> **Task 7.** A research design based on experimental and control groups will compare the uses of synchronous and asynchronous communications to collaboratively solve complex problems. Participants will use groupware and other communications software to engage in activities that are designed to gather data regarding the most appropriate uses of each model.

Task 8. Uses of information technologies will be examined in experimental and control group models to investigate and analyze the use of various media (e.g., electronic mail, computer conferencing, computer supported collaborative work). Variables will include the frequency of use, communication skills, reported success, comfort levels, learning curves, and generalizability into other activities.

Task 9. Factors that promote or interfere with individuals learning about and using information technologies will be studied. Through case studies and observations, the researcher will identify specific factors (personal, institutional, or organizational) that may hinder or facilitate the appropriate use of information technologies for collaboration, research, and communication.

Task 10. Online components of coursework will be evaluated. Investigation and comparison will determine the necessary characteristics of such components, with respect to pedagogical, organizational, and institutional issues.

Task 11. Summative report - draft of report due one month prior to deadline for revision.

Each task will now be described in chronological detail, to provide an overview as events occurred.

3.1 Task 1

Gather and organize data to understand the nature of the USAFA, cadet life, and current uses of information technology at the academy.

Several discovery modes provided data about the Academy and its use of information technology. Team members studied the curriculum and individual course syllabi in order to understand instructional demands upon technology and to identify naturalistic settings for group projects. A University of Georgia student who served an internship at the USAFA provided information about technological

facilities and cadet life, as did a USAFA graduate studying for a master's degree at UGA. Visits to the Air Force Academy by all team members on numerous occasions provided firsthand observations about Academy educational culture and politics. Interactions with instructors, department heads, the Project Coordinator, and the Visiting Professor provided further descriptive information. Hands-on experience with the installation of *LotusNotes* taught researchers a great deal about the capabilities and limitations of USAFANet. Preliminary surveys of cadets described their current computing and group skills and attitudes toward technology and group work.

Electronic communication provided further information. A listserv (see glossary) was set up to facilitate communication between and among team members, project personnel at the Academy, and instructional personnel. Later, discussions were held over TWISTER[1] to add groupware functionality to communication and cultural interchange. In this electronic discussion space, project participants commented upon the software itself, as well as design and implementation issues.

Data about the Academy were processed into database files and assimilated into a growing collection of documents and articles. These data yielded several benefits, including the identification of instructors willing to participate in collaborative online experiences. Insights from each of these information-gathering activities were combined with literature gleanings to provide a foundation for the research program, inform plans and procedures, and help prevent damage to the research goals or the educational customs of the Academy.

[1] TWISTER, a form of groupware, is the Web interface created during the second half of the project. It will be discussed in detail.

3.2 Task 2

Collect qualitative data on individual and group interactions, technologies and collaboration, and information regarding backgrounds of uses.

The investigators designed and arranged numerous groupware exploratory sessions in a variety of settings. In the first year, contexts included an educational telecommunications class at UGA and several informal groupware communications between members of the research team and Air Force personnel. Information collected from these experiences helped to formulate thinking about group interactions and collaborative learning theory in the planning of Task Four.

An extensive literature search for material on computer supported collaborative writing and problem solving continues to support pilot projects. The literature search helped to establish preliminary categories for analysis of textual data to be collected during the pilots. Statistical hypotheses helped to focus attention upon these categories.

In addition, three projects were initiated to test the implementation of groupware. These projects, respectively, took place in July 1996, November 1996, and Spring 1997.

Project One: July 1996. This first attempt employed *LotusNotes* as the groupware package to serve the instructional needs of a summer leadership course. Students were asked to use the software to assist a collaborative writing effort. Data sources included surveys, observer's notes, interviews with cadets and those involved, researchers' debriefings, videotapes, and groupware transcripts. This study yielded a great deal of quantitative and qualitative data about technology use, interactions, and collaboration. Pilot study results informed the continued

investigations into groupware and online collaboration. The major findings of this project were twofold:

1. *LotusNotes* requires tremendous onsite support, overwhelms users with powerful features of questionable use for the current educational requirements, and presents numerous technical challenges for network administrators.
2. Fragile group interactions were difficult to observe realistically, considering the overwhelming demands of the software, and the highly invasive observational methods used.

Project Two: November 1996. Another pilot study was planned for November 1996. By this time, a new Web-based software tool (TWISTER) had been designed to alleviate some of the problems experienced with *LotusNotes*. Six volunteer students in a military history class, divided into two groups, were to examine a controversial text passage and use the groupware to collaboratively analyze the text. This task was an authentic one in the context of instructional goals. Unfortunately, this study never took place due to administrative lab preemption.

Project Three: Spring 1997. A third project was planned for spring semester. This activity was to be a joint project involving two World History classes, two Military History classes, two Physics classes, and a remote Physics class at IUPUI in Indianapolis. Each class was to use TWISTER to conduct similar tasks over the course of the semester.

Preliminary surveys in the history classes established baseline data about individual technology use. These surveys gave insight into the computing and group

skills of the cadets and their attitudes toward technology, group work and collaboration prior to participating in the study. Students were to complete several small collaborative tasks to begin, and end with a more extensive task. In the history classes, this major task was to be for all cadets from each of the four sections to select an historical military event, assert a position, and defend a rationale centered about an event in history that is covered by both courses. Through this activity, cadets would have the opportunity to "experience" the event from both the military and world history perspectives.

In the physics courses, plans were to have cadets use TWISTER as a communication support tool as they worked through physics problems and puzzlers designed by the faculty. Unfortunately, the physics classes at the Academy and at Indiana University chose not to participate, and thus were dropped from the project.

As the project developed, use of TWISTER provided yet another data source, as all online communication was automatically logged by *WUSAGE* and within TWISTER. This automatic logging provided usage statistics and transcripts of online interactions. Unfortunately, one instructor accidentally deleted an entire folder of class communications. This regrettable loss points out a design flaw in the TWISTER software that is beyond our control. However, examination of the remaining data showed that students and faculty actively engaged the software as a tool for learning.

Analyses indicated that the history classes used TWISTER for similar tasks, including brainstorming, discussion, and task coordination. In some cases, students reported experiencing difficulties with the TWISTER interface. In addition, participants remarked upon the need for the ability to pull in outside resources and

complained about the excessive number of onscreen buttons. The history instructors suggested several useful improvements to the TWISTER software. Additionally, the instructor reported interesting observations of the interactions of his students. He felt that the students who rarely talk in class were able to communicate with less inhibition through TWISTER. He also found that students who participated asynchronously were able to summarize, organize, and synthesize the group activities in a reflective and supportive manner.

Team members investigated various usage analysis packages and chose *WUSAGE*. This software package tabulates Web site usage and displays data in multiple ways, including graphs and spreadsheets. In addition, the data are exportable for further manipulation. These statistics and logs helped during analysis to describe usage patterns.

3.3 Task 3

Evaluate "groupware" software, which allows real time interaction, collaborative problem solving, and participatory writing.

The project team and the Principal Investigator spent substantial amounts of time exploring groupware that might be appropriate to the instructional tasks anticipated at the Air Force Academy. Groupware software packages examined included *LotusNotes, TCB Works, Construe, Aspects, Collabrashare, Common Space, WebCaMILE, Ventana GroupSystems, Microsoft Exchange,* and *Common Space.* Investigations were complicated by the dynamic nature of new software development, as new versions of groupware packages became available, requiring

constant updating of feature information. Throughout the project, team members studied current literature to keep abreast of developments in this rapidly changing area.

Exploratory activities included a session for local pilot project participants to use the groupware equipment and software in the Business Management Computer Room at the University of Georgia after an initial visit and introductory demonstration. Investigators met several times with Dr. Alan Dennis, a leader in the field of groupware exploration and development. The Principal Investigator and a team member consulted with researchers from the Georgia Institute of Technology about some of their experiences and concerns with groupware and interactive educational telecommunications.

Team members gathered information necessary to support evaluation of groupware. A description of features indicative of exemplary educational groupware was delineated and an identification of evaluative criteria was begun. Team members developed an instrument, the Groupware Comparison Chart, to facilitate comparison between software packages. The team began to compile a database of groupware literature, as well as a collection of actual documents.

As investigations began to provide the necessary criteria to make a choice, explorations focused on *LotusNotes*, which seemed initially to best satisfy multiple project criteria. Team members learned the fundamentals of this powerful program through tutorials, supplemented by a presentation from a commercial consultant. As several technical challenges in the context of the NCL came to light, possible backup programs were identified in the case of the failure of *LotusNotes*. The two primary candidates for such a backup plan were *Construe* and *TCBWorks*, both

Web-based conferencing systems. Neither of these packages presented adequate substitutes for *LotusNotes*, in the opinion of the researchers, but was available if needed.

With groupware information in hand, investigators developed a research design for the summer pilot research project. It included two collaborative writing projects, one that would use collaborative groupware in the NCL, and one in which the group would not use collaborative groupware or the NCL. The Principal Investigator and graduate assistants traveled to the Academy for the final phase of this project, in order to observe the processes and collect data. A great deal of research and thought went into the consideration of a collaborative writing model, but the researchers chose to watch the spontaneous development of collaborative processes within the groups and compare this development across conditions.

The summer pilot studies made clear several issues related to the selection of a groupware product. As a result of the summer pilot studies it was clear that *LotusNotes* has potential to provide the needed environment in terms of flexibility, development, and the support of almost synchronous participatory writing. In these areas *LotusNotes* surpasses any other product examined by the team. However, it also requires extensive technical support time and attention, high level expertise, and administrative commitment. This is especially true if the goal is to integrate the product throughout campus to provide access from the NCL as well as dormitory rooms.

On each testing occasion technical difficulties occurred, prohibiting the cadets from signing on to USAFANet and/or *LotusNotes*. In all cases the technical problems were eventually solved. However, given the consistent nature of the

difficulty, the selection of *LotusNotes* as the software for use in these studies was re-evaluated. To better equip the project for future studies, more time from Academy personnel needed to be allocated and training made available. Because of the difficulties associated with the technical implementation of *LotusNotes*, investigators ended the first project year seriously considering a change to a new groupware product, *Common Space.*

However, *Common Space* was abandoned as a software choice as ease of access, control of research statistics, and ability to correct problems all became increasingly important issues. Attention turned toward a Web-based product. Construction of the Groupware Comparison Chart (See Appendix 7.1) led to the development of a Web-based system which incorporated the conferencing capabilities of *TCBWorks*, as well as other features. Team members met with the creator of *TCBWorks* to discuss the potential reprogramming of the product to meet the needs of the classes using the product during spring semester. During the meeting it was found that *TCBWorks* had been sold to SoftBicycle, Inc. and was being distributed under the new name *Consensus @nyWare*. The new product had many of the features envisioned for this project but was only available commercially. The University of Georgia retained full rights to use the original code of *TCBWorks* for research and educational purposes, but changes were needed for upcoming projects. The Principal Investigator met with a programming consultant to determine the feasibility of refining *TCBWorks* to meet the needs of the project. The decision was made to proceed with adaptation of *TCBWorks* into a specialized product called TWISTER. Development of TWISTER continued through the end of the project in the effort to add value, feasibility, and adaptability to the tool.

Team members felt that a Web-based product would provide more flexibility and would be more likely to be used. Thus, work began on the creation of TWISTER. This effort was enhanced by the use of *HotMetal*, an HTML editor. After demonstration at USAFA, team members made further changes and improvements in the product based upon feedback from various personnel.

Planning and experimental sessions took place during the January 1997 visit to demonstrate TWISTER to faculty and Armstrong Laboratory representatives, in the NCL. Also, the team needed to provide further information about the uses and capabilities of TWISTER, and introduce new participating faculty to the team. To enhance these training sessions, several tools were developed. A problem-solving exercise was designed to help attendees experience the software firsthand. Also, the "TWISTER Guide for Administrators" and "TWISTER Guide for Students" served as job aids for the workshop (see Appendix 7.9).

Another series of workshops was planned for May for faculty. Lana Bradley coordinated these workshops, which were open to volunteer attendees and library staff. Topics included World Wide Web applications from an information usage perspective, overall Internet orientation, search strategies, and information quality. Team members created extensive materials for these workshops. Presentations were created using the Web itself as a medium, as well as materials for the document camera. A special exercise provided hands-on experience for attendees. Each workshop participant received a booklet, containing Web addresses, information quality criteria, and self-paced activities for later use (see Appendix 7.5).

3.5 Task 5

Using materials and tutorials, participants will be trained to use the existing networks, and the groupware. Research personnel will assist Center for Educational Excellence in adapting their materials to incorporate and model information technologies.

The team brainstormed possible pilot projects using ideas gleaned from readings on the subject of groupware. Discussions were held negotiating the best ways to implement the projects.

The summer pilot project (Project One) explored implementation issues and made initial observations. For each of two assignments, cadets prepared a Leadership Application Paper as they had previously in the course. These papers, collaboratively created using groupware, were to be compared to the papers created without groupware. Normally the cadets would have completed the papers individually, but for these activities they completed the task in the NCL working in a group with other cadets. To prepare them for this exercise, they were given a site-specific job aid for the use of *LotusNotes* and a hands-on training session.

The fall project (Project Two) was to employ multiple authentic group activities involving both synchronous and asynchronous use of groupware technology. Given the range of activities the cadets were to complete, the software needed to support work from both the NCL and dormitory rooms. An NCL upgrade and other collaborative difficulties set back plans for this fall project. Instead, the trip of November 6-8 provided an opportunity for personnel to discuss and demonstrate the new TWISTER software. Informal workshops and individual

demonstrations helped in this process. For the most part, response to the new product was positive.

In January 1997, discussions began to plan a collaborative effort between the team and the Center for Educational *Excel*lence/Faculty Development section for workshops in the use of information technologies. To this end, Dr. Schrum met with the director and other members of Faculty Development department. Energy was expended on establishing possible activities and goals for the faculty. Additionally, the faculty development department needed to share the information about our project to others, in order to encourage possible interests or questions. A planning and experimental session was held during the January 1997 trip in the NCL to demonstrate TWISTER to faculty and Armstrong Laboratory representatives again, provide further information about its uses and capabilities, and introduce new participating faculty to the team. Unfortunately, many of those scheduled to attend the meeting needed to reschedule or cancel. Only two USAFA history faculty and a CEE staff person attended. Follow-up appointments were made with physics faculty. A team member spent considerable time with the CEE support staff person to provide in-depth instruction of TWISTER's features. By having onsite personnel trained in the use of TWISTER, some support and troubleshooting for TWISTER users could be managed locally instead of having to refer users to UGA.

For the May workshops, all three investigators traveled to the Academy to conduct the three one-hour sessions. Sessions were well attended and feedback was generally positive.

3.6 Task 6

As participants begin to use information technologies for research and problem solving, research personnel will use qualitative and quantitative methods to identify the types of activities completed, the nature of the collaborative work, the organizational structure of the groups that form electronically, and describe the observable impact of the technology.

According to the Project Closing Agreement, Task 6 was altered to reflect the shortened time frame: Begin to analyze types of work best suited to the online environment with quantitative and qualitative methods.

Data sources for this analysis were numerous. They included listserv communication between project personnel, *LotusNotes* online discussions, TWISTER discussions among student groups and project personnel groups, surveys, observation fieldnotes, interviews with cadets and project personnel, researchers' debriefings, videotapes, and products of class projects.

All data was processed into database files and assimilated into a collection of documents and articles. Software tools such as *SPSS, NUD*IST, WUSAGE,* and Microsoft *Excel* assisted researchers in this organization process. These data were eventually analyzed, leading to the conclusions reported in Section 4.5.

One important analysis tool generated by project activity is the Groupware Comparison Chart. Although designed to help in the selection of appropriate software based upon situational needs, this chart also indicates task types. This listing of task types in matrix form displays the capabilities of individual packages.

For qualitative analysis, preliminary categories were derived from groupware literature. Additional categories emerged through the process of open and reiterative coding. Through inductive analysis, patterns were observed which

form the basis of the findings reported in Section 4.5. The wealth of various data sources helped to provide data triangulation, as several different types of data supported conclusions. Further validation occurred through investigator triangulation, as all three team members derived conclusions separately and then compared findings.

Quantitative data were obtained from *WUSAGE*, which tabulates Web site usage and displays data in multiple ways, including graphs and spreadsheets. These statistics and logs helped to describe TWISTER usage patterns. Preliminary surveys in the history classes established baseline data about individual technology use. These surveys gave insight into the computing and group skills of the cadets and their attitudes toward technology, group work and collaboration prior to participating in the study.

Results of these analyses are reported in Section 4.5.

3.7 Task 7

Synchronous and asynchronous interaction, collaboration, and process

Originally, it was expected that a research design based on experimental and control groups would compare the uses of synchronous and asynchronous communications to support collaborative solutions to complex problems. Participants were to use groupware and other communications software to engage in activities that were designed to gather data regarding the most appropriate uses of each model.

Two complications altered the completion of this task in the original design. First, the contract was terminated early, with the result that the Closing Agreement

was changed to reflect a timeline that only began looking at this question. Second, the choice of software and creation of an infrastructure to support this task were never fully realized, and remained unstable throughout the life of this contract. This instability forced the researchers to modify their plans and adapt the questions to more modest circumstances.

Project One, July 1996, employed synchronous groupware activity. Using *LotusNotes*, students completed a collaborative writing assignment. Of the three groups, one was entirely co-located, while each of two other groups had one remote member. Under these conditions, researchers found that fragile group interactions were difficult to observe realistically, considering the overwhelming difficulties with the software and hardware, and the necessity of using highly invasive observational methods.

Project One, part two, also in July 1996, employed a combination of synchronous and asynchronous activity. Groups of four cadets were asked to select and visit a local business, investigate that business' style of leadership, and to collaboratively write a paper describing their findings. Once again software and hardware complications interfered with smooth completion of the task. Researchers again found their presence distracting to the participants. However, the tasks were completed. Interviews with several of the participants were conducted. As mentioned previously, Project Two (Fall, 1996), was never able to be implemented.

Project Three was conducted throughout the Spring Semester, 1997 and a more asynchronous model was chosen. This activity was designed to be a joint project involving two world history classes and two world history classes. (Note: in initial discussions two physics classes at the USAF Academy and two physics classes

at a remote university were to conduct another set of experiments, however this was never implemented.) The history classes used TWISTER for tasks such as brainstorming, discussion, and task coordination. Several synchronous discussions were held in one of the classes, and in the other two short activities were completed. Both instructors reported that students who rarely talk in class were able to communicate with less inhibition through TWISTER. They also found that students who participated asynchronously were able to summarize, organize and synthesize the group activities in a reflective and supportive manner.

One conclusion that emerged from the data reflected that both synchronous and asynchronous activities are useful, however, each has its own strengths and weaknesses. It was helpful to have interactive discussions, although the software apparently resulted in slight delays in the synchronous interactions. Participants related that it was helpful to have one or more of their teams participate in an asynchronous manner, to provide thoughtful reflection, summarizing comments, and to take a synthesizing role. Another conclusion reflected the need for substantial team and trust building. These were not able to develop, due to the short time frame of this activity. This complication is summarized in the following thought,

> The demanding nature of such an approach sets the stage for learning how individuals typically reason about such issues, not how they would reason given the opportunity to think long and hard about them.... difference between functional and optimal levels of performance. (King & Kitchener, 1994, p. 104)

This task has the potential to inform planning of technological implementations, and of creating appropriate ways to structure the uses of

synchronous and asynchronous activities. It is worthy of future funding and investigation.

3.8 Tasks 8-10

Please note that these tasks were removed from the contract as a result of the early termination date.

4.0 Report on Research

These research projects were created to determine the viability of using groupware to support collaborative writing and problem solving within the context of assigned projects within traditional face to face courses. A military service academy represented a unique opportunity to study such uses, because all participants had access to high-end technology, and yet they frequently enjoy little possibility to work together on group projects. Researchers recruited the professor of a summer class to participate in the initial pilot projects.

After exhaustive study of many groupware packages, researchers and personnel at the Service Academy determined that *LotusNotes* would be the most desirable choice for the pilot and actual experimentation. Once this decision was made, effort was expended in creating scenarios and job tools, and ascertaining hardware requirements for the implementation.

The researchers designed three significant research activities. The first occurred during the summer session, 1996, the second was not implemented, and the final one took place throughout the spring semester, 1997. The summer research studies were conducted with researchers onsite, however, for the spring semester the researchers were only onsite for short periods of time.

The summer class, a mandatory course focused on leadership, had twelve students. These students were enrolled during the summer primarily to reduce their fall semester loads, to provide more time for either sports or flight activities. The class met 15 times, for three hours per meeting. These students were all comfortable with computers, with electronic communications, and with group projects, however none of the 12 had previously used groupware.

The first activity consisted of students entering a networked computer lab, but having no prior information about their intended activity. They were given a brief introduction to *LotusNotes*. Then they were randomly assigned to groups of four and were given three hours in which to collaboratively write a paper describing an unpopular policy decision and ways in which leadership might respond to this circumstance.

During this pilot the students were given three hours in which to complete the task. Unfortunately, the hardware and software posed enormous problems for the students. Computers crashed, the software interfered with printing, and overall the perception of the groupware was largely negative. In spite of these difficulties, the groups did produce a collaborative paper, and managed to complete the assignment on time.

For the second activity, the instructor divided the twelve students into three groups of four. Their task was to visit an organization in the local area, either a business or other enterprise, identify its organizational culture and leadership patterns, and then to collaboratively write about their experience. They were to assess the situation as they saw it, and to analyze the organization with respect to the leadership attributes they had studied.

They were again asked to use *LotusNotes* in the networked computer lab to complete this project, and they again had three hours in which to accomplish this. One of the groups completed this task on one day and the other two groups completed this task on a separate day.

The third project took place throughout the spring semester, 1997. Four history classes, two on military history and two on world history, agreed to

participate in exploring the efficacy and impact of using TWISTER to support coursework. Originally the four classes were going to collaboratively create a scenario and debate a topic, however, this did not actually occur. Instead, most activity occurred within classes, as cadets created discussions and problem solved specific topics in their courses.

4.1 Literature review

The literature on information technologies, computer supported cooperative work, and communications involving group and social psychology has witnessed an explosion in the last fifteen years. Sproull and Kiesler (1991) have spent considerable time studying the changes that occur in group dynamics when individuals begin to use communication technology. Their theoretical framework is useful to understand the impact and changes inherent in the use of these particular technologies.

They have identified a two level model. "Most inventors and early adopters of technology think primarily about efficiency effect, or first level effects, of that technology" (Sproull & Kiesler, 1991, p. 1). They describe the second level system effects as having more importance and far reaching implications and consequences. "Doing new things leads to thinking in new ways and thereby to fundamental changes in how people work and interact. ... The more profound impact of computer-based communications may similarly come from changing patterns of organizational interaction" (p. 35).

It is also necessary to consider a framework that directly relates to the unique characteristics and goals of the USAFA. Lamb and Chin (1992) proposed an analysis that considers the operational realities and purposes in regard to Air Force training

issues, specifically as they relate to group processes. They suggested the analogy of the layers of an onion, moving from the space systems, through world systems, societies, and communities, to organizations, groups, and individuals. These last three "layers" relate to the present research, especially as communication patterns change when information technologies are added to existing communication patterns. They summarized their conception by stating, "By examining AF training needs and options from different levels of analysis, we see a single problem in several different ways. The problem may be apparent at one level but invisible at another" (p. 123). In regards to the present study, historically-established patterns of interaction may be considered as influencing the adoption of innovation.

It is important therefore that this research look beyond Sproull and Kiesler's first level effects, just as it is not enough to simply build a technology connection to "cyberspace." It is also imperative that energy be put into designing an environment that supports effective communication, collaborative work, and creative problem solving. According to Harasim, "Lessons gained over the past two decades of experience in network communication highlight the importance of designing the environment. Networlds are the intersection of social and technical systems; design involves both technical and social considerations" (1993, p. 29).

Learning the system can also be a significant task. Individuals seldom learn new skills by simply being exposed to them. Learning theorists assert the role of prior knowledge in helping to learn new skills (Flavell, 1981; Gilovich, 1991). Learners who readily gain the ability to manipulate software without much effort are likely to be transferring previously learned skills to the new context. Conversely,

learners experiencing difficulty adapting to a new system may be experiencing knowledge gaps or conflicts between old and new skills.

Authentic and mandatory activities increase the likelihood that participants will internalize the use of communication technology (Schrum, 1995). Once the environment has been constructed, the system has been learned, and individuals have authentic activities to perform, the scope of communications will broaden. "Users ... have shifted the emphasis from strictly utilitarian applications toward enhancing human contact and understanding on a planetary scale" (Feenberg, 1993, p. 186). Through research and pro-active planning an organization can prepare to use these potential changes to positive effect.

Computer communication offers a combination of qualities that include the spontaneity of spoken language and the thoughtfulness of written work (Kaye, 1987). Learners report greater control and responsibility toward their learning; students also find that the act of writing demands greater reflection than speaking (Rohfeld & Hiemstra, 1993). Several research and anecdotal studies have looked at online components of traditional courses and concluded that these components increase the communication between the teacher and the students, and among the students substantially, when compared with similar writing classes without the computer communication component (Hartman, Neuwirth, Kiesler, Sproull, Cochran, Palmquist, & Zubrow, 1994; Hiltz, 1990; Owen, 1993; Schrum, 1995).

Online communications work to flatten hierarchies and to increase the work completed within organizations by focusing on the message content, rather than the social or personal characteristics of the messenger (Zuboff, 1988). Individuals are forced to consider their contributions, and one researcher found that, in addition to

an increase in communication between and among participants, computer communication "acts as a heuristic device - it encourages students to assess their own work first" (Barrett, 1994, p 120).

Further, online interaction appears to foster a variety of social and professional communities and communications, but always within the context of individual responsibility, as "the world of electronic communication assumes and demands that people take initiative for their own learning and growth" (Schrum, 1993, p. 193). However, for some individuals, this may inhibit the adoption of information technologies.

Other difficulties of learning and using electronic communications may interfere with their adoption and use. Mason (1993) describes a common reaction, "[Electronic] conferencing has peculiarly unsettling effects – am I talking or writing, am I reflecting or interacting, am I isolated from or connected with other, ... a quality of displacement – of familiar experiences in unfamiliar places... " (p. 5). This represents a challenge that requires more study.

The USAFA has historically demanded and promoted individual work from its cadets, as have other institutions of higher education. Efforts are now under way to encourage collaborative and cooperative work, as evidenced by the importance given to this outcome. Electronic communication appears to foster collaboration and group interactions. In an extensive examination of on-line courses and components of courses, Mason and Kaye found much to applaud. They noted that the online environment presents "an opportunity, which never existed before, to create a network of scholars, "space" for collective thinking, and access to peers for socializing and serendipitous exchange" (1990, p. 23).

A number of research studies have investigated group communication and cooperative learning (Hiltz, 1990; Kaye, 1989; Manrique & Gardiner, 1994; Moore & Thompson, 1990; Owen, 1991; Romiszowski & de Haas, 1989). Studies vary in the tasks they investigated, but results have been remarkable in the similarity of their findings. While many encountered problems, they were typically due to lack of training, equipment, or clarity of assignments and goals. Overwhelmingly the participants in the studies were positive about their collaborative interaction, new opportunities, and the chance to create with others. Many studies also recommended that organizers show a sensitivity to each group's unique culture and to fostering ownership of that network by the participants.

Olson and Bly (1991) conducted a study of a distributed learning environment, in which individuals who were geographically distant from each other collaborated on a research project. They concluded that

> interpersonal computing supports people communicating and working together through the computer; it includes tools to support interaction separated by time and/or space as well as face-to-face interaction and meetings. ... Work forced the boundaries of social place to extend beyond the boundaries of physical place (p. 81).

This collaboration can also lead to cooperative problem solving, as in activities reported by Hunt (1994), where writing, responding to, and revising group writings fostered the generation of solutions. It can also lead to more productive evaluation, typically a one directional activity, which can turn into dialogical interaction that evaluates the learning, the teaching, and the activity of each member of the group.

Several studies have concluded that *online* communication results in strong communities, in which individuals collectively solve problems and provide support

for each other in a democratic and egalitarian manner (Bruce, Peyton, & Batson, 1993; Harris, 1993; Rice-Lively, 1994; Schrum, 1995).

Harasim summarized the characteristics of online courses or educational components of courses as: place and time independent, many to many communication that supports real collaborative learning, and dependent on text based communications to promote thoughtful and reflective commentary (1990).

Collaboration can be through a network, as in the studies mentioned above, or it can be an outcome of using current groupware for collaborative writing and work. The term groupware refers to software that supports and augments group work, including but not limited to "electronic mail, bulletin boards, asynchronous conferencing, group schedulers, group decision support systems, screen-sharing software, and so on" (Greenberg, 1991, p. 1).

One study of computer supported cooperative work (CSCW) involved electronic communications using GroupSystems as supplemental to traditional meetings for two geographically distributed groups in a large organization. Researchers reported that "Members of both groups reported that the GroupSystems meetings were more effective, efficient and satisfying than the regular meetings of these groups" (Valacich, Dennis, & Nunamaker, 1991, p. 148). Other CSCW studies have looked at the social psychology of groups, group decision support systems, and new methodologies for investigation. In an examination of several studies on group dynamics in computer communications, Lea and Spears (1991) concluded that research "underestimated the role of social contextual factors and normative processes in [computer mediated communication]" (p. 171).

There is a clear need for continuing research to expand and clarify the body of knowledge on emerging communication technology that will continue to make an impact on cadets while they are at USAFA and later as they assume leadership roles in the Air Force. It is difficult to find technology rich environments with stable populations and authentic activities in which to study this phenomenon; however, the USAFA represents just such a unique opportunity.

4.2 Methods

4.2.1 Data sources. A case study approach is an appropriate manner in which investigate this type of emerging phenomenon, particularly in a situation that is evolving and in which it is important to ascertain the participants' understandings of the processes. Qualitative methods "are a source of well-grounded, rich descriptions and explanations of processes occurring in local contexts" (Miles & Huberman, 1984, p. 15). Efforts were expended to triangulate the data sources and methods, and to include all possible opportunities to understand the experiences from as many perspectives as possible; these included analysis of written documents and group discussions, as well as individual's perspectives (Lincoln & Guba, 1985; Miles & Huberman, 1984). The text exchanges and responses were captured for analysis, as much as possible. Individuals were invited to participate in individual electronic or telephone interviews that were designed to investigate the program processes document variations among and between participants, and sought to understand and describe the events and resulting impacts. The qualitative data were coded by the researchers and then compared, analyzed, and synthesized based on emerging themes.

Methods also included Likert type pre- and post-test surveys (see Appendix 7.3) of all participating students, electronic and on-site observations, semi-structured interviews with randomly selected participants and instructors, and analysis of transcripts of group process work. Additionally, the research team met several times during the life of the research projects in order to debrief, compare observations, and summarize questions.

Once the date for termination of the contract was determined, research team members traveled to USAF Academy and conducted final interviews with one of the instructors, the two members of the research team located at the Academy, and with some of the cadets who had participated.

4.2.2 Participants. This research project was created to determine the viability of using groupware to support collaborative writing and problem solving within the context of projects that are assigned in courses that meet in a traditional face to face model. It was essential to choose as a testbed in which the use of the technology would not present an insurmountable obstacle to the research. A military service academy represented a unique opportunity to study such uses, because all participants have access to high end technology, and yet they have little possibility to work together on group projects.

The participants in these studies were cadets registered in required courses. They were given consent forms to complete, and were told exactly the types of tasks in which they would be involved. Each cadet had the option of refusing his/her participation, with the promise of no resulting grade or status difficulty.

4.2.3 Analysis. Data analysis methods included statistical analyses of the pre- and post-tests and content analysis of the observations, interviews, and transcripts of

group processes. Quantitative analyses included descriptive statistics, correlations, and ANOVA models. The researchers individually coded the qualitative data as a triangulation strategy. After the coding was complete, the researchers met to compare, analyze, and synthesize the results that emerged from the previous analyses. Specific analytic tactics included pattern and theme recognition, clustering, and contrasting (Miles & Huberman, 1994). Analytical software, including *QSR NUD*IST, SPSS, WUSAGE,* and *Microsoft Excel* streamlined data handling chores. The utilization of multiple methods and peer interaction was designed to triangulate the research perspectives and increase the understanding of the participants' perspectives and response to the activities using groupware.

4.3 Limitations of this research

It is essential, in any research project, to identify the limitations that may result from factors inherent in the circumstances of that research. The culture of the USAF Academy is unique among undergraduate institutions. The cadets are chosen from among a pool of the best and brightest high school students, and they have demonstrated *Excel*lence in academics and athletics, and as well as exhibited leadership skills. Once they are selected, they then have to continue to demonstrate an ability to balance the incredible schedule of activities, as well as compete to earn a place in the highly sought "pilot school."

The cadets have an honor code that guides their lives, and impacts their scholarship. Grades, while important to all undergraduates, are perhaps especially important to this group of individuals. Unlike other participants in research, these cadets may see themselves as having no real choice to refuse any requests to

participate in the research. These conditions, taken together, appear to make the results of research conducted at the USAF Academy not generalizable to other postsecondary institutions. Given what we know about comparing any two institutions, it is important to keep this reality in mind.

Another limitation concerns the nature of conducting research on an emerging condition or implementation of an innovation. Much research relies on hypothesis building and testing, however, the traditional paradigm does not work in the current environment, primarily because the body of theory is not robust enough for hypotheses. Additionally, the technology is constantly changing, the learning curve is steep, and the requirements to actually implement the technology are variable and non-trivial. It is clear that creating hypotheses does not make sense at this point, although it is equally clear that it may become an important method in which to test our understandings at some time in the future. We know that the questions one asks about the appropriate uses of any technology have more to do with how it is used, how instruction is changed or influenced by it, and how learning is impacted by it. Yet during our work at the USAF Academy, our focus was still on investigating and setting up the technology, and in making it work. It is useful to review one expert's perspective on this issue:

> ...cognitive psychology and it s associated research method, controlled experimentation - seemed not to offer the most appropriate kinds of concepts and tools to capture a rich understanding of how work is accomplished. Such accounts tended to focus exclusively on learning as an individual phenomenon, rather than something that takes place between people and in communities....

> The ethnographic method, through participant observation, pays attention to how actors construct their understandings with others through a set of shared practices. Developing such a rich understanding of the world of work for a community of workers can help designers to understand the complex interrelationships between people, artifacts and settings that are an integral part of getting the job done. (Bannon, 1996, p. 14)

4.4 Obstacles encountered

The researchers' initial efforts to test the use of groupware and information technology with classes at the USAF Academy faced many obstacles. These obstacles taught valuable lessons about the educational and technology systems inherent within the culture of the academy. Additionally, these obstacles resulted in compromised data so it is essential that these obstacles be explicated.

4.4.1 Hardware. During summer, 1996, two research activities took place, and are described elsewhere in this report. These were organized to utilize the Networked Classroom Laboratory (NCL) for teaching about the software involved in the project (*LotusNotes*). Unfortunately, the machines in the NCL were old and could not adequately support the needs of the software. Several of the computers crashed repeatedly during the sessions and resulted in frustration for the participants and researchers.

The structure of the networking that exists within the Academy and its hardware also created complications for cadets in accessing their copies of the software and their individual data. Cadets experienced difficulty with the printing during two of the projects.

4.4.2 Software. Due to the evolution of groupware during the life of this contract, and the continual changes made to individual packages that the researchers explored, the researchers were never able to end this part of the project. Eventually, the research team did settle on *LotusNotes* for the initial research pilot studies. Unfortunately, this complex and robust software package has an extremely steep learning curve and resulted in confusion and frustration for the participants. The difficulty with the hardware only served to exacerbate the problems.

Additionally, the expectations for the software continually changed, and generally expanded. No one person at the Academy was designated as the software support person, and since it was impossible to support all the needs of the cadets at a distance from the University of Georgia, this issue was an ongoing source of difficulty. After the research team settled on a hybrid creation of *TCBWorks* and a custom-designed Web home page, controlling and modifying the software became easier. Team members were able to make needed corrections and modifications, adapt it to specialized activities, and provide resources and continuing support.

4.4.3 Negotiated arrangements with faculty. A major component of designing research projects at the Academy involved substantial interaction with the faculty. Busy schedules and competing demands of faculty members' lives complicated this communication process. Although the negotiations with faculty began quite well, they ultimately became a concern for the research team, specifically as they might impact the research agenda. The research team was unable to access the faculty easily, and structurally it was unclear how they saw the research activities assisting the learning and teaching process. The establishment of clear lines of communication, management, and reporting was a constant difficulty.

Ultimately, roles for each participant were not well delineated, and the complications that resulted from this difficulty are impossible to accurately determine.

4.4.4 Support issues. Ongoing and consistent support became a significant obstacle to carrying out the research during the summer and fall, 1996. *LotusNotes* is a complicated software package, and it requires a *LotusNotes* administrator with access, responsibility, and knowledge regarding the uses and support. It was essential that consistent and reliable Help Desk support be available for users at all times. This did not occur at any time, and therefore, the frustration with the *LotusNotes* software was significant.

Further, one criterion for choosing a software package was that it be accessible from anywhere using the World Wide Web. *LotusNotes* had recently made that feature available in its program. This feature meant that the cadets would be able to communicate with each other and work on projects from their dormitory rooms, which had always been a substantial goal of the entire contract. Unfortunately, the committee responsible for making decisions about this type of activity did not allow the cadets to access the *LotusNotes* Server from locations other than the NCL. They also did not allow the research team to access the NCL server from the University of Georgia, due primarily to the configuration of the USAF Academy firewall. Thus it would have been impossible for the researchers to support and modify software if the projects had continued to use *LotusNotes*.

4.4.5 Other Issues. Two further issues bear mentioning in considering the complexities that impacted the project's experiments. First is the concern of time. Time is a continuing constraint in all research, but in the case of the first two projects,

it was perhaps more of a difficulty. More time was needed to establish infrastructure, learn the software, and to configure the hardware, prior to expecting cadets to complete a substantive task. Research suggests that when participants are asked to complete tasks without having a level of comfort on software, the energy expended is in learning that software rather than in accomplishing the task, and it is probable that this impacted the research studies in this contract.

It is important to mention one other concern that the research team shares. The use of the video cameras during the first two pilots was extremely detrimental to the quality of the interactions between researchers and participants, and generally interfered with the interactions among the participants. Every cadet who was interviewed commented on the use of these cameras, and in reality, the videos did not add to our understanding of the processes.

4.5 Results

The results of these research projects provide new information and confirm the literature in several areas. Table 1 reviews the data sources and lists the analysis method(s) and tools used for each one.

Table 1. Data Sources and Analysis

Data Source	Analysis Employed
Pre-survey data	Descriptive statistics (SPSS, *Excel*)
Post-survey data	Descriptive statistics (SPSS, *Excel*)
Observations	Emergent theme analysis (*QSR NUD*IST*)
Interviews (students, instructors, Dr. Lamb, Dr. Pletsch)	Emergent theme analysis (*QSR NUD*IST*)
Debriefing sessions (research team)	Emergent theme and comparative analyses (*QSR NUD*IST*)
TWISTER logfiles	Descriptive statistics (*WUSAGE*)
LotusNotes logfiles	Descriptive statistics, correlations, ANOVA (*SPSS, Excel*)
Videotapes of lab sessions	Emergent theme analysis (*QSR NUD*IST*)

Unfortunately, the researchers feel that the difficulties encountered severely compromised the reliability of the data. Given the problems with the hardware and software, and the artificial nature of the assignments, expectations for major findings to inform future practice were not extremely high. Nevertheless, data were generated and gathered, resulting in important findings. The reader must use caution in interpreting and applying these findings because of the constraints already noted. Nevertheless, results may inform planning of future projects and enhances understanding of groupware and collaboration.

4.5.1 Project One: Summer pilots. In the summer 1996 activities, each group began its assignments with a flurry of messaging, which tended to promote a "division of labor" collaborative writing model, and a good deal of humor. The initial activity appeared to be an organizational phase, in which they all participated.

Some volunteered for tasks ("I'll do the body") and other tasks were assigned by skills. For example, one cadet was assigned the task of "turning it into English." After they brainstormed and designed their strategies, it was clear that they then individually worked to actually gather resources and begin their writing tasks.

LotusNotes generated logfiles consisting of a list of each message, its sender, time launched, and size in bytes. These data became the basis for statistics generated from the first experiment. These statistics are presented in Table 2. As can be noted, the mean (1.73) indicates that subjects were not using the threading feature of *LotusNotes* to full advantage. A pattern that emerged from the log data is that subjects in general sent many short messages early in the session. Toward the end of the writing session, network traffic slowed considerably, but individual message length increased significantly. This pattern was consistent across groups, and is almost certainly related to the collaborative writing model chosen by the groups. In other words, descriptive statistics support the pattern emerging from the qualitative data. This pattern included an early division of labor in each group, less communication in the middle phase as individuals worked separately on their assigned tasks, and a final exchange of bulky messages as the group compiled its document.

Table 2. Measures of Central Tendency

Variable	Definition	Mean	Variance	Min.	Std Dev	Range	Max.
Bytes per message	Avg no. of bytes per message per individual	814.29	279850.95	372.50	529.009	1583.50	1956.00
Level*	Avg level no. per message per individual	1.73	.08	1.38	.29	.88	2.25
Average time	Amount of time (in fractions of minutes) between message launches	7.83	8.06	3.69	2.84	8.60	12.29
Bytes per minute	Avg. no. of bytes per minute	106.31	1304.13	67.41	36.11	114.54	181.95
Bytes-to-level ratio	Ratio: bytes/level	491.26	151828.74	200.58	389.65	1221.97	1422.55
Longest time	Avg. of individual max. times in group	29.80	125.33	7.43	11.20	35.99	43.42
Max byte/group	Group avg. of max. byte	4570.88	3392417.27	2197	1841.85	4461.00	6658.00
Min byte/group	Group avg. of min. byte	115.75	483.93	84.00	22.00	64.00	148.00
No. msgs. per group	Avg. number of messages per group	12.50	6.29	8.00	2.51	7.00	15.00
Shortest no. of minutes per group	Avg. of minimum minutes in group	.93	.12	.53	.34	1.12	1.65
Total bytes per group	Sum of total group bytes	9323.63	15426901.1	4506.00	3927.71	11142.00	15648.00
Total minutes per group	Sum of total group minutes between messages	88.25	622.50	48.00	24.95	63.00	111.00

Yet, despite the difficulties, the groups reacted with enormous patience, even during 30-minute computer downtimes. They seemed unconcerned that their deadlines were fast approaching, the system was not working, or that they could not print their reports. Video and observations recorded signs of stress and frustration in a few individuals such as facial grimaces, slamming a mouse on the desk, fidgeting, and off-task behavior. These actions are representative of only a small fraction of observed behaviors. Interestingly, subsequent analysis of *LotusNotes*

transcripts generates the conclusion that cadets were more upset by the use of videocameras than they were by software failure. For the most part, adaptive behaviors dominated. Students reverted to their word processing and electronic mail systems when the groupware failed.

The descriptive statistics listed above should be considered valid and reliable. However, comparative and correlational analyses of these data are of questionable validity because the assumption of independence between groups was violated. Observation data indicates that groups interacted with each other and influenced each other's work. Also, the technology crashed repeatedly, which accounts for large gaps in the logfile data. This unexpected occurrence contributed to additional interaction between groups. In addition, the extremely low number of subjects prevents a satisfactory establishment of statistical power. With the understanding that these data are unreliable, a few cautious observations are worthy of note.

Table 3. Oneway ANOVA Results

Variable	dF	F Ratio	P value	Sig. y/n	Levene p/sig	Post hoc sig.
Avg. Byte	2,5	5.04	.06	n	---	
Avg. Level	2,5	.20	.82	n	---	
Avg. Time	2,5	18.42	.01	y	.06 close	groups 1,2
Bytes per minute	2,5	2.92	.14	n	---	
Byte/level ratio	2,5	2.10	.22	n	---	
Longest time	2,5	.08	.92	n	---	
Max byte	2,5	2.66	.16	n	---	
Min byte	2,5	.58	.59	n	---	
Min total	2,5	8.18	.03	y	.12 n	none
Number messages	2,5	2.66	.16	n	---	
Shortest time	2,5	.45	.66	n	---	
Total bytes	2,5	8.57	.02	y	.30 n	groups 1,2
Total level	2,5	.26	.78	n	---	

Oneway ANOVAs were run, comparing group means on each variable. Three significant differences were found in the omnibus F-tests: average time per message, total number of minutes, and total bytes. Post hoc tests were performed on these scores, using the Bonferroni adjustment. A significant difference was found on

the average time variable between Groups 1 and 2 and on the total bytes variable between Groups 1 and 2. No significance was found in contrasts between groups on the total minutes variable. The significance for the average time variable is questionable because the Levene test for homogeneity of variances approaches significance. However, because the more important assumption of independence is not met, a violation of the assumption of equal variances is of little concern.

Table 4. Significant Correlations

Variable	Pearson's r	p value
Avg time/Byte level ratio	.79	.02
Bytes per min/Btye level ratio	.87	.005
Byte level ratio/ avg time	.79	.02
Total minutes/Group	.80	.018
No. msgs/byte level ratio	-.78	.02
Total bytes/Avg. time	.86	.006
Total bytes/Bytes per min	.78	.022
Total bytes/byte level ratio	.80	.017
Total-level ratio/Avg level	.81	.015
Avg. byte/Avg. time	.86	.007
Avg. byte/bytes per min.	.90	.003
Avg. byte/byte level ratio	.96	.000
Avg. time/total-byte ratio	.86	.006
Max byte/Total bytes	.82	.012
Total-level ratio/No. msgs	.86	.006
Avg byte/Max byte	.71	.048
Avg byte/No. msgs	-.74	.037
Avg byte/Total byte	.92	.001

Significant positive correlations indicate several relationships:

- The relationship between average time per message and byte/level ratio indicates that quick messages, short messages, and shallow messages tended to occur together. Observation data seems to indicate that cadets were frustrated by the inconvenience of opening messages, and this reluctance to use deep message levels may be reflected in this correlation.
- The higher the group number, the more time they spent in between sending each message. In other words, Group 3 spent more time than Group 2, which in turn

spent more time than Group 1. This figure does not necessarily represent the length of time spent composing, but more accurately indicates the time between each message launch. It is possible that the time between sending messages was spent reading and writing. Observational data is inconclusive on this point. Observers did note that cadets often forgot to refresh their screens, which caused an artificial inflation of time between message launches.

- The high correlation between total bytes and average time between messages supports the idea that cadets were producing words in between message launches, instead of simply reading or doing nothing.

Significant negative correlations indicate an important inverse relationship between byte levels ratios and the number of messages generated. The greater the number of messages, the lower the number of bytes per message. This relationship may seem obvious, but again indicates that cadets were working in between communications rather than wasting time.

In this pilot study, statistics and qualitative conclusions seem to concur. Qualitative conclusions resulted from a categorical breakdown and cross-comparison of textual units. A listing of codes generated around the data from this project appears in Appendix 7.4.1. These codes were further grouped in a hierarchy within *QSR NUD*IST*. Unfortunately, *NUD*IST* does not support detailed charting. The reader may gain a general idea of what a *NUD*IST* hierarchical tree looks like by referring to Appendix 7.4.2.

In summary, the major findings of Project One were twofold:

1. *LotusNotes* requires tremendous onsite support, overwhelms users with powerful features of questionable sue for minimal educational requirements. It presents numerous technical challenges for network administrators.
2. Fragile group interactions were difficult to observe realistically, considering the overwhelming demands of the software, the highly invasive observational methods used, and because the observers were continually distracted by subjects' need for technical assistance.

4.5.2 Project Two: Fall history class. This project was to have taken place in November and December of 1996, in the NCL at the USAFA. The goal was to have groups of cadets investigate the Vietnam War, using electronic resources, to respond to an article posted by the instructor. The response was to have been created collaboratively with group members contributing research, information, and opinion. Although the research team committed resources to supporting this activity and to preparing for it, ultimately it did not take place, due to technical and scheduling difficulties with the NCL.

4.5.3 Project Three: Spring history classes. Analyses indicated that the history classes used TWISTER for tasks similar to those used for the summer projects using *LotusNotes*. These included brainstorming, discussion, and task coordination. In some cases, students reported experience difficulties with the TWISTER interface. In addition, participants remarked upon the need for the ability to pull in outside resources and complained about the excessive number of onscreen buttons. the history instructors also suggested several useful improvements to the TWISTER software. Additionally, one instructor reported interesting observations of the interactions of his students. He felt that the students who rarely speak in class were

able to communicate with less inhibition through TWISTER. He also found that students who participated asynchronously were able to summarize, organize, and synthesize the group activities in a reflective and supportive manner.

4.5.4 Section summary. Overall, an electronic network did enable and support efforts toward collaborative and group activities (Schrum & Lamb, 1996). Interaction was fostered and students were individually responsible and accountable for that interaction, and for the ultimate products. Strategies to accomplish the tasks were identifiable from the work and discussions, as well as from the interviews conducted. Leadership patterns and roles emerged, although it is unclear how the nature of the task impacted these roles.

From the observations, interview comments, and transcripts, it was clear that the students felt that they could have more easily accomplished each task without using the network and groupware, or could have used the network with electronic mail and attachments. They also felt that even if the technology had worked perfectly it would not have been better than their traditional manner of group work. In reality, the situation was artificial, considering that participants sat in one room while multiple researchers observed them. Also, the task was artificial nature in the sense that accomplishing it using technology was more complicated that accomplishing it through talking. The combination of these artificial factors was understandably disconcerting to the participants.

From these pilots and other investigations, it is also clear that tasks given to learners must be relevant and authentic. Imposing quiet on the participants would have assisted with the experiment. However, such an imposition would have been difficult to enforce and would have increased the artificial nature of the task, as well

as interfered with their learning. Equally onerous for the students was the researchers' use of videocameras. This irritation was mentioned unanimously by the individuals who were interviewed.

Beyond the nature of the task, a great deal was learned about the planning and support necessary for actually carrying out a project using groupware. First, technical support is essential. All components of the technology must be running smoothly, and those hardware glitches that can be identified as potential hazards must be resolved. Choosing a software package that can accomplish necessary tasks, given the nature of the learning experience, and yet not overwhelm the participants and support system is a delicate balancing task. Additionally, sufficient time must be allowed for learning and experimenting with the groupware.

Second, it is clear that all personnel must have a stake in the success of the project. This ownership of the project is essential if individuals are expected to learn new skills, to provide timely assistance, and to tackle difficult problems. Third, it would be extremely helpful to determine which participant prerequisites (i.e., knowledge and skill with computer applications) are significant to the success of the activity.

The results of the spring 1997 semester projects were equally inconclusive. The obstacles identified in Section 4.4 detail these issues, but from the work completed it is clear that the cadets did gain valuable experience, shared information, and collectively produced reports through the groupware and interactions.

Synthesizing lessons from these experiences, the literature, and other communications (Barrows, 1995; Guzdial, January, 1997, personal communication)

the researchers identified support structures for geographically separated learners. It became clear that some activities are logically completed collaboratively (brainstorming, identifying the problem, choosing the place to begin, designing a solution, and testing out that solution) and others for which groupware and collaboration are not particularly useful (constructing and writing documents). Those creating such projects would be wise to structure activities with organizers and frameworks that encourage learners to explore ways in which the tools actually enhance their work. Giving learners control and support for self-determination of appropriate uses will accomplish the goals more successfully.

Distance education represents a step toward lifelong learning so individuals can maintain professional expertise, share information, and work collaboratively. Technology can support these goals with interactive networks and groupware, which allows synchronous and asynchronous discussions, collaborative activities, and group decision-making. This research looked carefully at the emerging phenomenon of online and collaborative learning.

These research efforts represent a first step at investigating the use of groupware for collaborative learning experiences. These studies demonstrate that groupware holds potential for interactive collaborative learning, and distance education for many activities, but is not completely successful for all learners in all situations.

Lessons learned from these experiences have informed planning for using groupware, and assist instructors in creating viable courses and assignments for both teaching and learning. Results suggest positive outcomes for content learning, and some strong suggestions for improving the structure and process of this type of

online activity. Further research is needed to provide more information regarding best practices in using groupware for content specific learning, collaborative problem solving, and group processes.

5.0 Implications and Recommendations

This contract was conceived and originated to investigate the uses of information technologies at the USAF Academy with the purpose of expanding their use to improve learning and teaching, as well as training, throughout the Air Force personnel. It is important to remember this guiding goal. As Hodas indicates, machines cannot change organizations simply by providing a new way to accomplish old tasks "but by causing them to change their conception of both what it is they do and the world in which they do it" (Report of the First Global Classroom Youth Congress, 1993).

Given the context and experiences, the research team believes much has been accomplished toward the goals of the project. Excellent beginning steps have been taken, and the level of interest regarding using groupware to support collaborative learning is extremely high among USAFA faculty (as evidenced by the attendance and interest at the workshops). We offer the following recommendations for future work in this area:

- It is essential to remember that the technology must fit into the culture of the organization, as it exists. It is almost impossible to ignore the circumstances under which the planned changes may need to occur.
- Establish a collaborative project opportunity grant, in which faculty and researchers can create academically and pedagogically sound projects using information technologies. These grants might support innovative projects, travel, and research for faculty willing and eager to use their classes for well crafted research.

- Identify one or two faculty members in each department to gain experience and knowledge of information technologies for that discipline. These individuals might be offered an incentive for taking on this role in the department.
- If innovation is to be encouraged and valued by the faculty, it must also be seen as valuable to the administration. It would be helpful to institutionalize a system of rewards and encouragement for the type of risk-taking that is involved in all innovative practice. This might include the establishment of technology proficient internships for master and doctoral level graduate students. It might reward such innovation in other ways.
- Students must also perceive the value of participation in experimental work using information technologies. The time necessary to learn new software and hardware must be taken into account as part of the cadets' responsibilities.
- The potential for delivering training, upgrading skills, and establishing true live-long learning for the entire Air Force population cannot be overstated. The research team strongly suggests that research be continued in all areas of Air Force responsibility and at all levels of training.

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7.0 Appendices

7.1 Groupware comparison Chart

7.2 Research Instruments

7.2.1 Pre-Survey

7.2.2 Post Survey

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7.2.4 Instructor Pre-project questionnaire

7.2.5 Research Team Focus Group Guideline and Individual Interview Protocol

7.3 Pre-Survey Results

7.4 *QSR NUD*IST* Products

7.4.1 Codes

7.4.2 Hierarchical Tree

7.5 Workshop Materials

7.6 *WUSAGE* Statistics

7.7 TWISTER Organization Chart

7.8 TWISTER Examples

7.9 TWISTER Guides

7.10 Glossary

Comparison of Groupware Products for use in USAFA Research Projects

Feature\Software	Lotus Notes	Group Systems	Web Camile	Construe	Aspects	Common Space	TCBWorks	First Class
Communication								
Synchronous (chat)	3	1	2	3	3	3	2	1
Asynchronous	1	1	1	2	3	3	1	1
Wide area communications	1	3	1	2	3	3	1	1
Passing Documents	1	2	1	1	2	2	3	1
Data Collection								
Automated data collection	1	2	1	3	2	2	1	3
Multiple views for data analysis	1	2	1	3	2	2	2	3
Exportability/data usability	1	2	1	3	3	3	1	2
Problem Solving								
Ability to pose problems	1	1	1	1	3	3	1	1
Threaded Discussions for shared groups, solutions and brainstorming	1	1	1	3	2	2	1	1
Collaboration								
Support collaborative writing/editing	2	2	1	2	1	3	3	2
Shared and updated work space	1	1	1	2	3	3	1	1
Compatibly with other productivity applications	1	2	2	2	2	2	3	2
Process Support								
Structure	1	2	1	1	2	2	2	2
Model	1	2	1	2	2	2	2	2
Teacher support and feedback	1	1	1	1	3	3	1	1
Flexibility to modify or replicate	1	3	2	3	2	2	3	2
Implementation Issues								
Hardware requirements	3	3	3	1	3	3	1	2
Upgradeable / software	3	3	3	3	3	3	1	1
Personnel requirements for prog., admin., & helpdesk.	3	3	3	1	2	2	1	2
Additional needs to implement/install								
Hardware ?	YES	YES	YES	NO	YES	YES	NO	NO
Software ?	YES	YES	YES	NO	YES	YES	NO	YES
Personnel ?	YES	YES	YES	NO	NO	YES	NO	NO

Scale: Based on expectations of research team.
1 - Meets or exceeds expectations
2 - Meets expectations with compromise
3 - Does not meet expectations

7.2 Research Instruments

7.2.1 Pre-Survey

Part A. Read the following statements and circle the number that best describes how you would fill in the blank.

1. I am _____ using computers.	1 2 3 4 5 uncomfortable comfortable
2. I use my computer _____.	1 2 3 4 5 rarely often
3. I _____ upon my computer to help me do my work.	1 2 3 4 5 do not depend depend greatly
4. I have found that when I use a computer to accomplish work, it _____.	1 2 3 4 5 takes me longer saves me time
5. Learning new computer programs is _____.	1 2 3 4 5 a hindrance worthwhile
6. I learn new computer applications _____.	1 2 3 4 5 slowly quickly
7. I am _____ to learn new computer applications.	1 2 3 4 5 not eager eager
8. Electronic communication makes communication _____.	1 2 3 4 5 difficult convenient
9. I _____ the meaning of the word "groupware".	1 2 3 4 5 do not know know
10. I _____ how to use groupware.	1 2 3 4 5 do not understand understand
11. I have used groupware _____.	1 2 3 4 5 never often
12. Groupware _____ with the group's work.	1 2 3 4 5 interferes assists
13. I _____ taking classes during the summer.	1 2 3 4 5 dislike enjoy
14. I am a(n) _____ writer.	1 2 3 4 5 poor *Excel*lent
15. I _____ receive good grades on my written compositions.	1 2 3 4 5 rarely usually
16. I _____ writing in groups.	1 2 3 4 5 dislike like
17. I write with groups _____.	1 2 3 4 5 never often
18. I feel _____ working in groups.	1 2 3 4 5 uncomfortable comfortable
19. Working in groups is	1 2 3 4 5

_____ .	inefficient efficient
20. In groups, work is _____ fairly distributed.	1 2 3 4 5 not usually usually
21. It's _____ to think of new ideas when working in a group.	1 2 3 4 5 harder easier
22. Products of group work are of a _____ quality than products of individual work.	1 2 3 4 5 lower higher
23. When working in groups, I _____ take on a leadership role.	1 2 3 4 5 never always

Part. B Complete the following Chart

Software Type	Used? Y/N	How long?	I use this software for....
Email			
Word Processor			
Groupware			
Whiteboard			
World Wide Web			

Part C. Please answer the following questions in your own words:

1. Why did you enroll in this leadership class this summer?

2. What would you like to learn in this leadership class?

3. Complete this sentence: When I am asked to participate in group work, I feel...

7.2.2 Post Survey

Part A. Read the following statements and circle the number that best describes how you would fill in the blank.

1. I am _____ using computers.	1 2 3 4 5 uncomfortable comfortable
2. I use my computer _____.	1 2 3 4 5 rarely often
3. I _____ upon my computer to help me do my work.	1 2 3 4 5 do not depend depend
4. I have found that when I use a computer to accomplish work, it _____.	1 2 3 4 5 takes me longer saves me time
5. Learning new computer programs is _____.	1 2 3 4 5 a hindrance worthwhile
6. I learn new computer applications _____.	1 2 3 4 5 slowly quickly
7. I am _____ to learn new computer applications.	1 2 3 4 5 not eager eager
8. Electronic communication makes communication _____.	1 2 3 4 5 difficult convenient
9. I _____ the meaning of the word "groupware".	1 2 3 4 5 do not know know
10. I _____ how to use groupware.	1 2 3 4 5 do not understand understand
11. Having access to computers at the NCL and in my dormitory has made it _____ to do the group writing assignments for this class.	1 2 3 4 5 harder easier
12. Groupware _____ with the group's work.	1 2 3 4 5 interferes assists
13. Lotus Notes _____ facilitate the group writing assignment.	1 2 3 4 5 did not help helped
14. Using computers in class made it _____ to accomplish the group writing assignments for this class.	1 2 3 4 5 harder easier
15. It is _____ to do group writing assignments with computers than without computers.	1 2 3 4 5 inefficient efficient
16. I _____ writing in groups.	1 2 3 4 5 dislike like
17. I feel _____ working in groups.	1 2 3 4 5 uncomfortable comfortable
18. Working in groups is	1 2 3 4 5

_____.	inefficient efficient
19. In groups work is _____ fairly distributed.	1 2 3 4 5 not usually usually
20. It's _____ to think of new ideas when working in a group.	1 2 3 4 5 harder easier
21. Products of groupwork are of a _____ quality than products of individual work.	1 2 3 4 5 lower higher
22. When working in groups, I _____ take on a leadership role.	1 2 3 4 5 never always
23. Overall, I would _____ that using groupware has more advantages than disadvantages when writing with a group.	1 2 3 4 5 disagree agree

Part B. Please answer the following questions in your own words:

1. What did you learn from the experience using groupware in this class?

2. How did you feel about the experience using groupware?

3. Complete this sentence: When I am asked to participate in groupwork using groupware, I feel.....

7.2.3 Student interview protocol

This protocol is open-ended and non-prescriptive to serve as a guideline for interviewers.

1. Describe how you feel specifically about working in small groups in class situations.

2. Has your attitude about groupwork changed during the course? How? Why?

3. In what ways did the group process change between the first project and the second? Did the use of technology have any impact, positive or negative?

4. What do you think about groupware? In what ways did it help or hinder your work?
   - What did you like about it? Dislike?
   - Describe how you used the program synchronously? Asynchronously? What advantages did you see to either mode, or both?
   - Name any elements in the learning environment(e.g. classroom, instructor, technology, etc.) that detracted from learning. Contributed to.

5. Did you complete your writing assignments in class? Did you get together with your group outside of class?

6. Tell me about the interactions between the people in your group.
   - Did people assume roles? How did this happen (did someone take charge, or what?)
   - Would you describe the interaction as *reciprocal, parallel, sequential,* or ??? (explain terms)
   - Describe any conflicts you might have had.
   - Were you able to talk freely?
   - Talk about constructive, critical, and distracting comments. Was there a difference in these between the first group project and the second?
   - Did you learn anything from the others in your group? What?

7. Compare for me your experiences writing or solving a problem alone as opposed to your recent experience working with a group?

8. As a learning experience, how would you characterize the groupwork portion of the course?

9. For females:
   - How did you feel about being the only (or one of a few) women in this course? when working on the group writing assignments?
   - Did groupware or the technology make any difference?

10. What would you differently if you were to write with a group again?

11. Would you like to use groupware for future group projects?

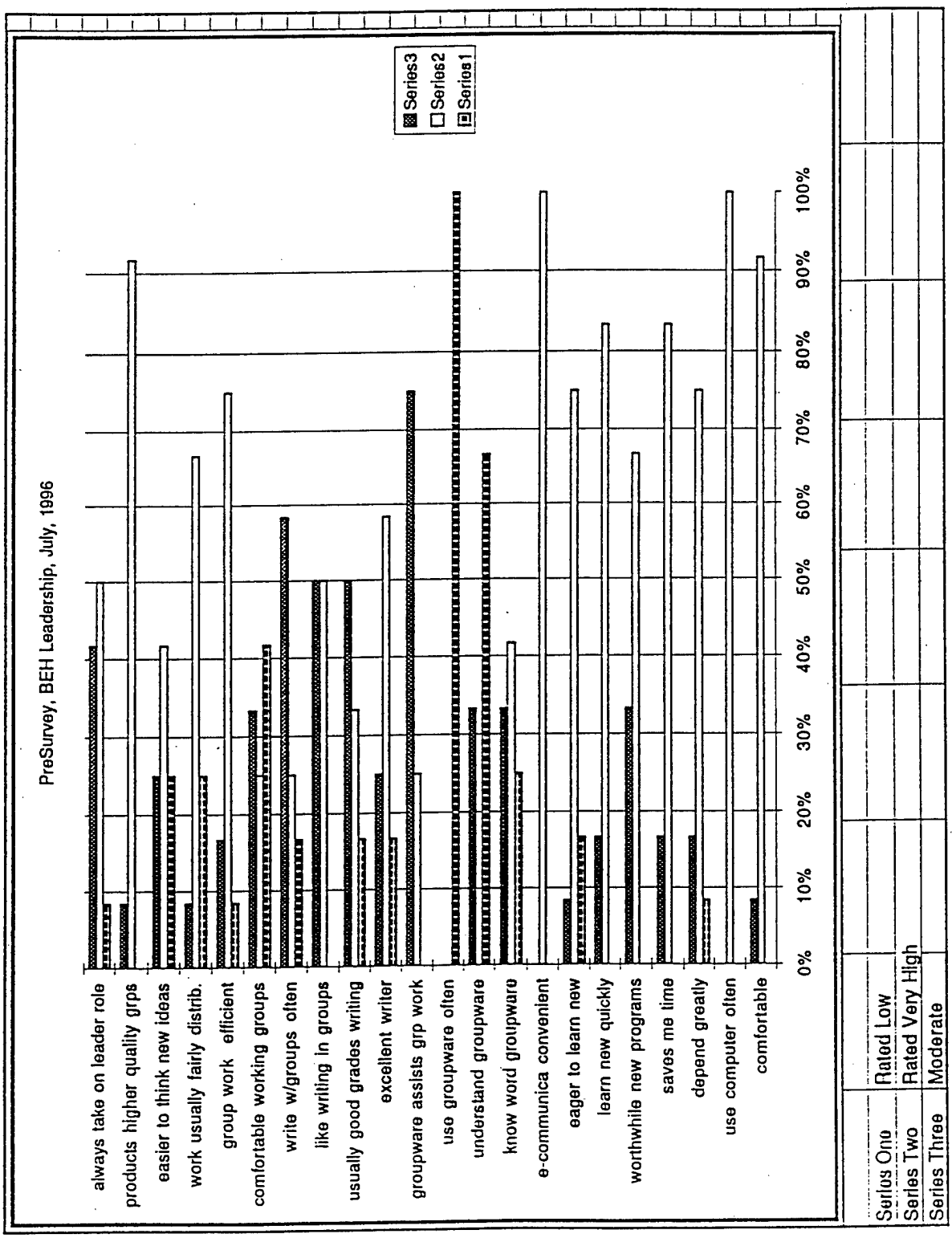
7.2.4 Instructor pre-project questionnaire

1. Describe your feelings about collaborative work for learning purposes.
2. What experiences have you had with using student groupwork as a learning method in the past?
3. How do you expect to TWISTER will help or hinder your teaching?
4. How do you expect TWISTER will help or hinder your management of instruction?
5. What problems do you expect to encounter? What problems do you expect the student to have?
6. What changes in student achievement do you expect to observe when comparing student work done with and without TWISTER?

7.2.5 Research team focus group guideline and individual interview protocol

1. What were your goals for this project? Were they achieved?
2. What have you learning about technology?, education?, groupware?
3. What lessons have you learned about collaboration?, research?
4. Describe your experience working with faculty in the USAFA atmosphere.
5. If you could go back, what would you do differently?
6. Identify the major problems you saw with this project.
7. Where do you see the use of groupware in the future? in general?, in the military?, educationally?

7.3 Pre-Survey Results



7.4 *QSR NUD*IST* Products

7.4.1: Codes

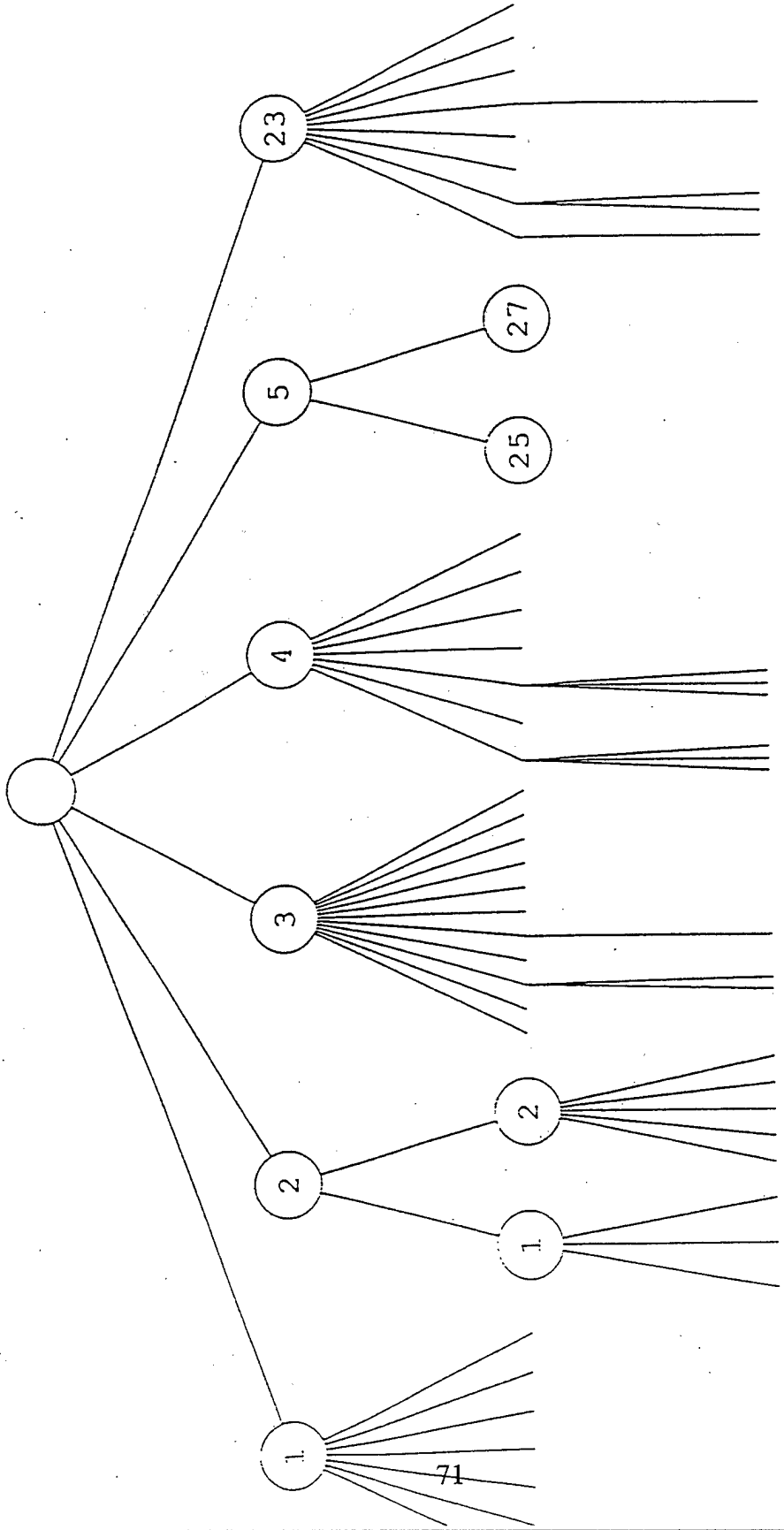
PROJECT: afa

(1)	/problems
(1 3)	/problems/better ways
(1 11)	/problems/slow
(1 12)	/problems/glitch
(1 14)	/problems/painful
(1 17)	/problems/complex
(1 26)	/problems/time
(1 30)	/problems/dislike
(2)	/software
(2 1)	/software/features
(2 1 22)	/software/features/format
(2 1 32)	/software/features/cursor
(2 1 33)	/software/features/functionality
(2 1 34)	/software/features/navigation
(2 2)	/software/types
(2 2 13)	/software/types/email
(2 2 16)	/software/types/chat
(2 2 20)	/software/types/mail
(2 2 36)	/software/types/Windows
(3)	/processes
(3 1)	/processes/learn software
(3 10)	/processes/accomplished task
(3 15)	/processes/collaborative writing
(3 15 18)	/processes/collaborative writing/edit
(3 15 41)	/processes/collaborative writing/compilation
(3 19)	/processes/manage
(3 26)	/processes/time
(3 26 35)	/processes/time/flurry
(3 28)	/processes/application
(3 37)	/processes/improve
(3 39)	/processes/distance
(3 42)	/processes/startup
(3 45)	/processes/ideas
(4)	/questions
(4 1)	/questions/q1
(4 1 1)	/questions/q1/yes
(4 1 2)	/questions/q1/no
(4 1 3)	/questions/q1/so-so
(4 2)	/questions/q2
(4 3)	/questions/q3
(4 3 1)	/questions/q3/positive
(4 3 2)	/questions/q3/negative
(4 3 3)	/questions/q3/so-so
(4 4)	/questions/q4
(4 5)	/questions/q5
(4 6)	/questions/q6
(4 7)	/questions/q7
(5)	/advantages

```
(5 25)          /advantages/easy
(5 27)          /advantages/interesting
(23)            /collaboration
(23 15)         /collaboration/collaborative writing
(23 15 18)      /collaboration/collaborative writing/edit
(23 15 41)      /collaboration/collaborative writing/compilation
(23 24)         /collaboration/solitude
(23 29)         /collaboration/synchronous
(23 31)         /collaboration/communication
(23 31 9)       /collaboration/communication/verbal communication
(23 31 9 38)    /collaboration/communication/verbal communication/voice
(23 31 9 43)    /collaboration/communication/verbal communication/discussion
(23 31 21)      /collaboration/communication/bulletin board
(23 40)         /collaboration/face to face
(23 44)         /collaboration/one computer
(D)             //Document Annotations
(F)             //Free Nodes
(T)             //Text Searches
(I)             //Index Searches
(C)             //Node Clipboard - 'navigation'
```

7.4.2: Hierarchical Tree

(Note: numbers identify codes and have no quantitative meaning)



Navigating Cyberspace--

Searching the Web

A workshop presented to
Faculty at the United States
Air Force Academy
May, 1997

Lynne Schrum
Mary Ann Fitzgerald
Lara Luetkehans
Department of Instructional Technology
The University of Georgia, 607 Aderhold Hall, Athens, GA 30602
706-542-3810

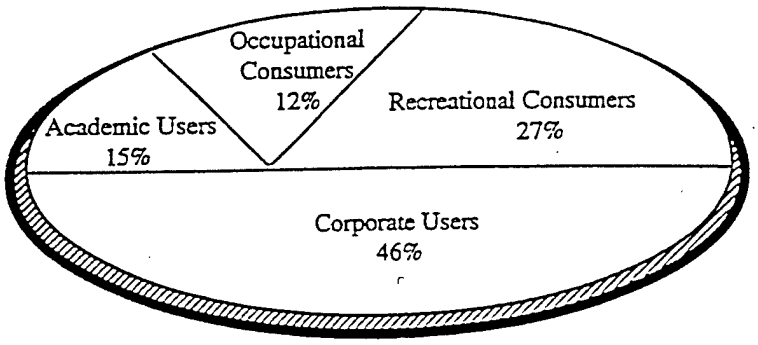
AGENDA

A Librarians' Introduction

to the World Wide Web

Introduction, Overview of the Internet
Search Engines and strategies
Activity - Discussion -
Misinformation - What do we need to know and teach?
Professional and curricular possibilities
Practical teaching suggestions

The World Wide Web Today!

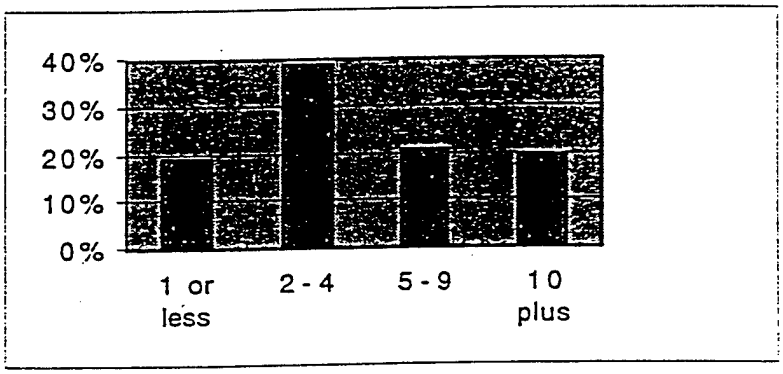


★ About one in 10 Internet users (more than 3 million) is a child under 18 who uses the Internet from home or school. (source: CyberAtlas Survey Consensus)

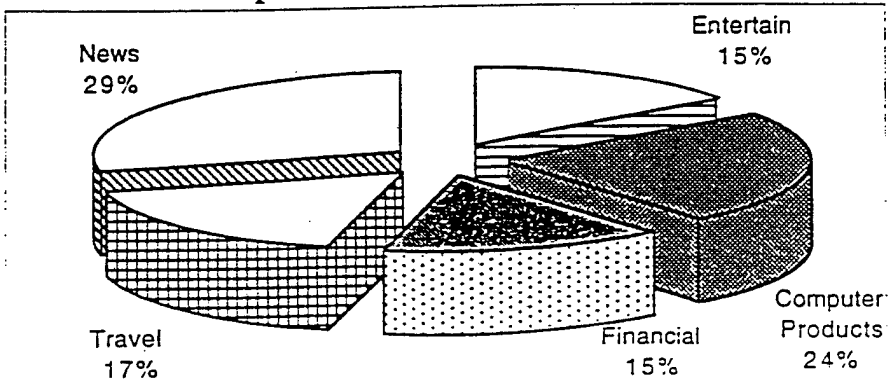
★ According to Nielsen Media Research, 64% of users have at least a college degree, which reflects the influence of academia on the Internet.

★ A consensus of various studies indicates that 32% of Internet users are female.

★ **Weekly Hours Online**



★ **Top Reasons for Using the Web:**



Tools for Teaching World Wide Web for Curricular and Professional Activities

Could you use any of these for your curricular activities?

Activity	Possible Uses	My uses or potential uses
Current Information	Access to constantly updated maps, data, & news	
Library Materials	Sources not available in library	
Connection to others	Interaction with experts, colleagues, & others	
Post your materials	Locate syllabus, readings, student writings	

Could you use any of these for your profession activities?

Current Information	Stay informed, maintain resource files	
Library materials	Access unavailable resources	
Connection to others	Professional organizations colleagues for collaboration Immediate answers for practical problems	
Posting	Prepublication feedback	

Which of these might be the most useful for you?

What do you need to be able to do this? Resources? Time?

Who in your department might already know about this?

Misinformation Markers

(These are easy-to-recognize cues that can alert the reader to the possible presence of misinformation. They are not proof of misinformation.)

- Requests or demands for money, especially credit card numbers
- Requests for private information such as phone numbers and address
- Contradictions
- Author credentials that do not match subject matter
- "Facts" on online discussion groups
- Anonymous authorship
- Contextually old publication date or lack of date
- Domain of site seems inappropriate
- Errors
  - spelling, punctuation, grammar (Schrock, 1995)
  - internal inconsistencies
  - mathematical
  - information is wrong (dates, names, etc.)
- Appeals to emotion:
  - flattery, fear messages, language that evokes guilt, sympathy
- Opinion Markers:
  - Subjunctive verbs: could, might, would
  - Opinion verbs: believe, think, assume
  - Qualifiers: probably, maybe, almost, supposed, perhaps-
  - Hypothetical situations: if, suppose
  - Predictions of the future: will, ought to
  - Adjective qualifiers: fine, unnecessary, scandalous
- Promises of a "quick fix"
- Claims that are "too good to be true"
- Simplistic conclusions from a complicated study
- Recommendations based on a single study
- Studies that ignore differences among individuals or groups
- Projections, predictions
- Testimonials

Search Engines

Alta Vista - One of the largest search engines, and widely considered the best.
altavista.digital.com

Excite - A good search engine with a large database. Some advanced searching allowed.

www.excite.com

Infoseek Ultraseek - Newly improved search engine with up to date database.

www.infoseek.com

Lycos - Large search engine with limited options for fine tuning a search.

www.lycos.com

The Open Text Index - Allows precise searching.

index.opentext.net

Webcrawler - Simple to use, but also allows advanced searching.

webcrawler.com

HotBot - Large, powerful search engine.

www.hotbot.com

MetaSearchers

MetaCrawler - Searches 9 major search services with your search terms, eliminates duplicates, invalid addresses, and collates results. Allows some advanced searching.

www.metacrawler.com

SavvySearch - Searches 3-5 search engines at a time. Offers less capability to do advanced searching.
www.cs.colostate.edu/~dreiling/smartform.html

Evaluations and Comparisons of Search Engines

Search Engine Reviews - Evaluations of 19 search engines.
www.cnet.com/Content/Reviews/Compare/Search

Understanding WWW Search Tools - A brief outline of the features, strengths, and weaknesses of each search engine.
www.indiana.edu/~librcsd/search

Searching the Internet: Automated Search Indexes - Reviews eight of the major search engines in terms of their ability to support Boolean, proximity, and field searching.
rs.internic.net/nic-support/nicnews/archive/september96/enduser.html

Advanced Searching: Tricks of the Trade - In depth evaluation of Alta Vista, Lycos, Open Text, and Infoseek. (From May 1996 issue of Online).
www.online.com/onlinemag/MayOL/zorn5.html

Subject Directories

Yahoo - The largest and most popular subject catalog.
www.yahoo.com

Galaxy - Another widely used organizer, similar to Yahoo.
www.einet.net

The WWW Virtual Library - 50 independently maintained subject guides. Each subject area is kept current by an individual with expertise in that field.
www.w3.org

Selective Directories

Point - A Lycos product that attempts to identify the top 5% of all Internet sites.
point.lycos.com

WebGems: A Guide to Substantive Web Resources - A very selective service that includes only about 1000 of the most significant Internet sites.
www.fpsol.com/gems/webgems.html

Reference Web Sites

AVIS Maps - Can be slow in loading map images.

www.avis.com/maps

Biographies
biography.com

Calculators Online
www-sci.lib.uci.edu/HSG/RefCalculators.html

Four11 E-mail Directory
www.four11.com

How far is it?
www.indo.com/distance

The International Database - Census data for many countries from 1950-present with projections to 2050.
www.census.gov/ftp/pub/ipc/www/idbprint.html

Museums Around the World
www.icom.org/vlmp/world.html

Peterson's Education Center - Information on graduate and undergraduate programs of study.
www.petersons.com

Roget's Thesaurus
web.cs.city.ac.uk/text/roget/thesaurus.html

Switchboard - US residential and business telephone directory.
www.switchboard.com

The Universal Currency Converter - Provides current exchange rates.
www.xe.net/currency

WWWebster Dictionary
www.m-w.com/netdict.htm

Zip Code Look-up
www.usps.gov/ncsc

Internet Searching Exercise

1. Use at least two of the Internet search engines, Alta Vista, Lycos, Excite, or Infoseek to execute a keyword search on a topic of your choice. List your topic and keywords below.

How many hits did you receive?

Do you need to limit your search by using additional terms or Boolean connectors? How would you modify your search?

How do the results from each search engine compare?

2. Try the same search with one of the meta searchers, SavvySearch or MetaCrawler. How do the results compare to the above?

3. If you were to try finding similar information with one of the Internet Directories, e.g. Yahoo or Galaxy, what path would you take?

4. Was there much duplication in the results from the above searches?

5. How do you feel about the quality of the search results and Internet sites you found?

7.6 *WUSAGE* Statistics

Throughout the course of the spring semester projects that used TWISTER, World Wide Web server login statistics were captured. These statistics were then analyzed through a product called *WUSAGE*. *WUSAGE* uses the server login files to produce reports on the files on the server accessed and the characteristics of the machines accessing the server. It also sorts data by date, hour, domain name, site and document.

The following charts are a summary of the statistics gathered from January 1, 1997 through June 20, 1997. These reports only reflect the top 25 documents and sites served. It should also be noted that these numbers are great deal higher than what may be evident in the TWISTER transcripts. A great limitation in the transcript analysis is that one of the history professors inadvertently deleted an entire session on TCBWorks. The accesses for this session are reflected here, but not in the saved transcripts.

Of the total 27,356 accesses to the server during this time, military accesses from the server name, heimdall.usafa.af.mil, were the highest with 5,099 accesses. The number one document served was the TWISTER homepage.

Summary of Statistics for TWISTER

Time period: 01/01/97 to 06/20/97

Item	Accesses	Bytes
Overall Hits	27,356	52,116,785
Home Page Accesses	306	188,842

Unique sites served: 455

Unique documents served: 740

Top 10 Documents by Access Count

Rank	URL	Accesses	Bytes
1	/~aimhigh/twister/twistinf.htm	791	232,200
2	/~aimhigh/twister/twister.htm	779	96,696
3	/~aimhigh/twister/twismen.htm	659	157,377
4	/~aimhigh/twister/images/afablu.gif	630	1,470,144
5	/~aimhigh/twister/images/hm.gif	627	55,695
6	/~aimhigh/twister/images/tool.gif	626	52,152
7	/~aimhigh/twister/gtmenu.htm	625	130,935
8	/~aimhigh/twister/images/twister1.gif	617	1,667,768
9	/~aimhigh/twister/images/granite.gif	604	1,349,888
10	/~aimhigh/twister/images/tltr.gif	598	217,464

Top 10 Sites by Access Count

Rank	Site	Accesses	Bytes
1	heimdall.usafa.af.mil	5,099	4,220,508
2	128.192.24.156	4,782	5,234,260
3	128.192.78.166	1,488	1,102,143
4	128.192.24.154	543	1,431,984
5	irix.coe.uga.edu	493	632,875
6	itech9.coe.uga.edu	433	933,696
7	199.77.250.12	347	118,126
8	128.192.24.120	328	1,887,130
9	user-168-121-39-81.dialup.mindspring.com	287	39,996
10	sage.coe.uga.edu	280	199,922

Top 5 Domains by Access Count

Rank	Domain	Accesses	Bytes
1	Unknown	13,673	28,673,909
2	mil	5,166	4,400,842
3	edu	3,632	12,768,221
4	com	3,105	4,255,142
5	net	1,410	1,306,343

7.7 TWISTER Organization Chart

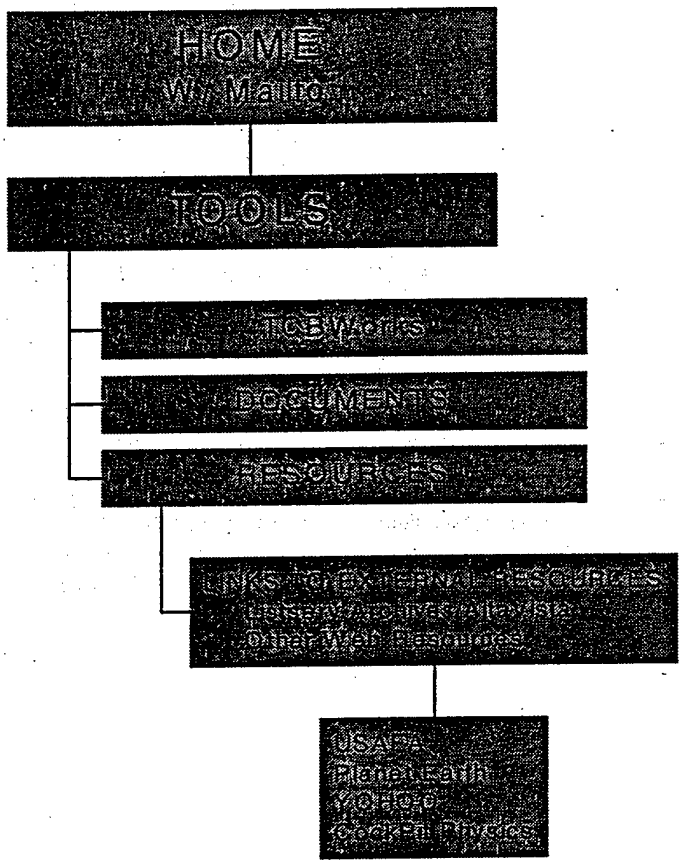


Figure 7.7.1 TWISTER Organizational Chart

7.8 TWISTER Examples

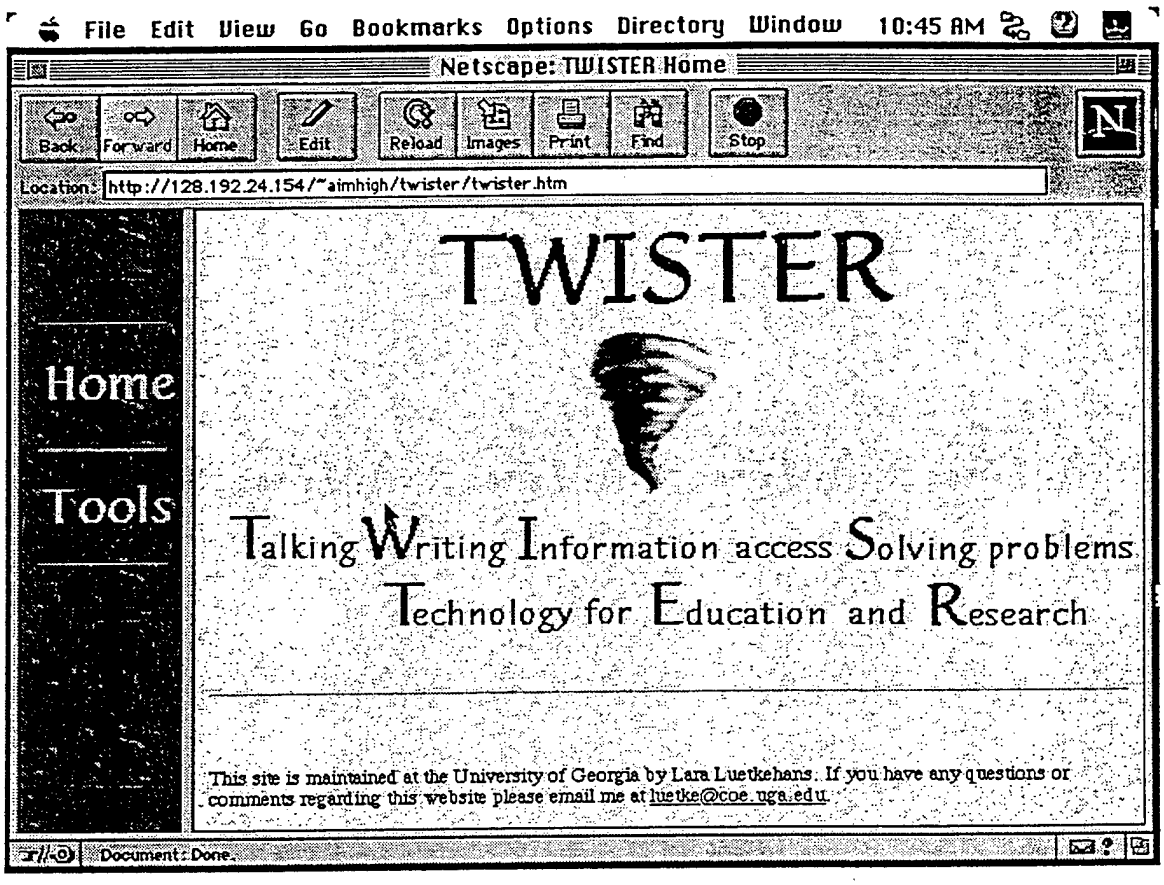


Figure 7.8.1 TWISTER Homepage

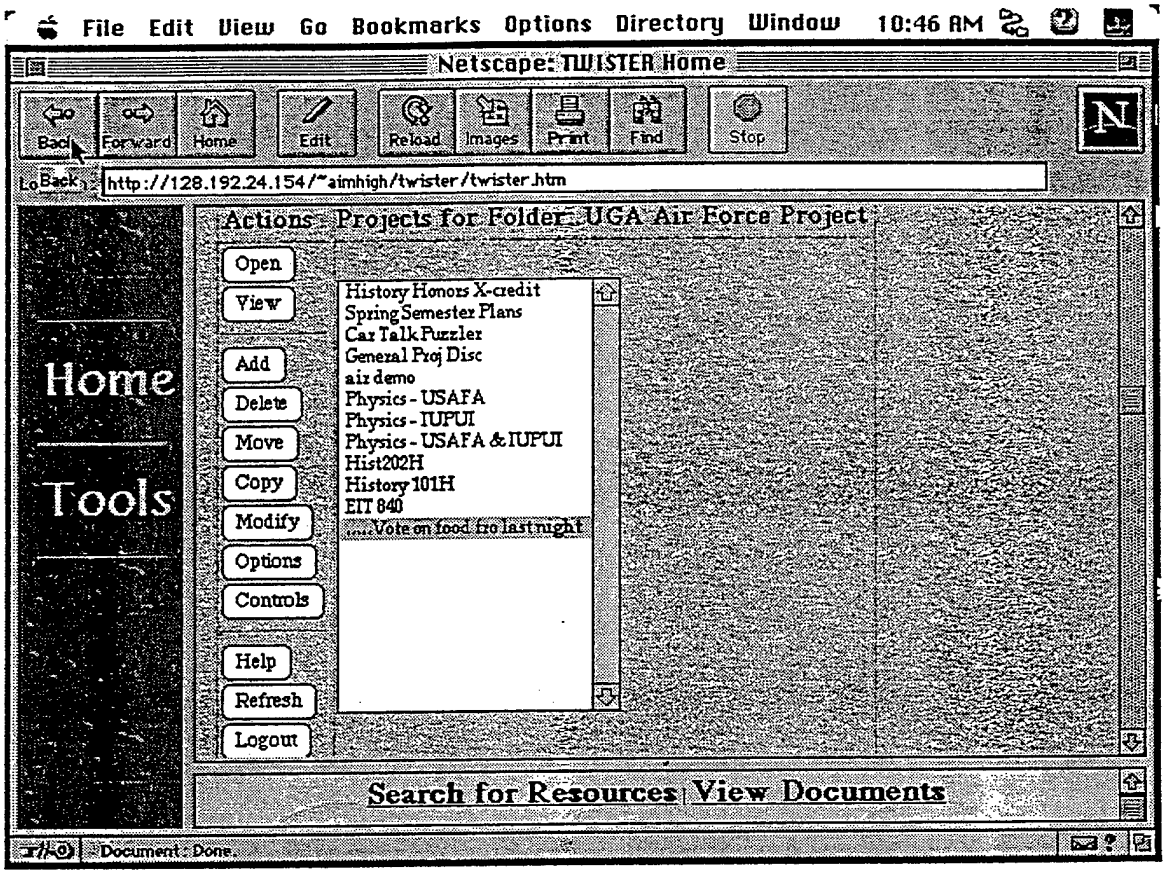


Figure 7.8.2 TWISTER Projects Area

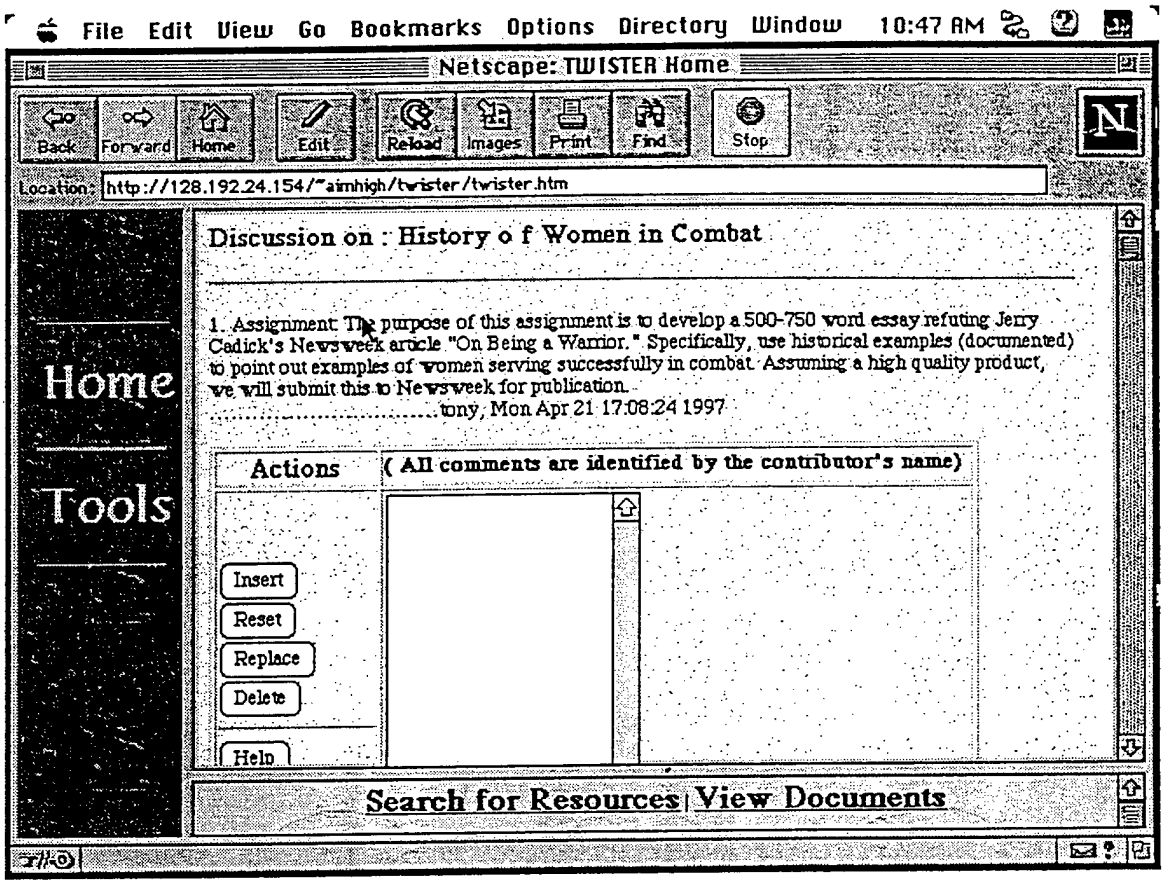


Figure 7.8.3 TWISTER Discussion Area

7.9 TWISTER Job Aides

7.9.1 TWISTER Guide for Administrators

TWISTER
Guide for Administrators
URL: http://128.192.24.154/~aimhigh/twister/twister.htm

TWISTER Home Page

Home Brings you to the home page. Note: if you select Home after you have entered TCBWorks, it will automatically log you out of TCBWorks.
Tools Brings you to main working screen. Provides access to TCBWorks, and other project related documents.

Tools

TCBWorks - This is the groupware packaged with TWISTER to support communication among participants. In case of technical difficulties with TWISTER, TCBWorks is accessible directly via http://tcbworks.cba.uga.edu.

Search for Resources - This provides access to WWW resources, including the Alta Vista search engine and other project related materials. If there is a resource that needs to be posted please contact Lara Luetkehans, the TWISTER administrator, at luetke@coe.uga.edu.
View Documents - This provides access to document resources. These might syllabi, student papers, past discussions, or other project related materials. If there is a document that needs to be posted please contact Lara Luetkehans, the TWISTER administrator, at luetke@coe.uga.edu.
Back - Use this back button instead of the one in your browser for controlling the Resources/Documents frames.

TCBWorks - There are *Excel*lent help screens available within TCBWorks; please use them. They will be especially helpful for detailed information. The following are quick tips for the features available to you.

TCBWorks entry screen

Folder Name: **air**
Your Name: **first name** (first 18 characters; lower case)
Password: **first name** (first 7 characters; lower case)

TCBWorks Projects - In the 'air" folder there are several projects listed. As an administrator you have access to all of the projects. After selecting the project, use one of the following commands.

Open This will open the project and take you to the Topic Screen for that Project.
View This allows you to see a list of all of the topics and comments that are in the Project.
Add This allows you to add new projects for discussion.
Delete This allows you to delete projects when they are no longer useful.

Move This allows you to change the order in which the Projects are listed in the Projects box.

Copy This allows you to make an exact duplicate of a project.

Modify This allows you to change the name of a Project.

Options This allows the Project Organizer to select which actions can be performed by participants, and which user can access the project in what way.

The different User Types are:

Owner: The person who created the Project. Owners can perform all actions at all times within their Project, including changing the Options.

Participant: A participant can only perform those actions specified by the Owner.

Observer: An Observer may View the Project but has no other access (i.e., read-only).

No Access: This means that the user may not even open the Project and will not know the project exists.

Controls Controls allow the Administrator to add, delete, and modify users of TCBWorks and to specify the Default Project Options used by all newly created Projects.

Refresh TCBWorks does not automatically update your screen whenever a Project, Topic, or Comment is added, deleted, or changed. This means if you are on a screen and someone else adds something new to TCBWorks, you will not see that new entry. Refresh reloads the page and checks for new entries. Every so often you will need to click on the Refresh button to see if anything new has been added. Refresh is performed automatically any time you perform any action (e.g., add, delete).

Logout This allows you to exit from TCBWorks, but not from TWISTER.

Topics - After you open a Project, you will be brought to the Topic Screen. From here you will see a list of the topics being discussed within the Project. This screen also has many actions for topics which are similar to those for Projects.

Discuss This allows you to read and add to the comments within a topic.

Vote This allows you to vote on Topics within a Project. See Voting (below or in TCBWorks' online help) for more information.

Add This allows you to add new Topics.

Delete This allows you to delete a Topic, when it is no longer useful

Modify This allows you to change the name of a Topic.

Move This allows you to change the order in which the Topics are listed in the Topics box.

Copy This allows you to make an exact duplicate of a Topic.

Combine This allows two or more Topics to be combined into one topic. When two or more topics are combined, all comments for all topics are copied into one topic.

View This allows you to a list of all of the Topics and Comments in the Project.

Options This allows you to select what actions are permitted and whether comments are anonymous or identified for each existing topic. Newly added topics take their options from those specified in the Project Options.
Back This allows you to go back to the Project Screen to choose a new Project or to Logout from the system.

Comments - From the Discussion Screen, you can read and write comments on a particular topic. The Topic is listed at the top of the screen. The comments are next and are listed in numerical order. At the bottom of the screen is the input box with the Action buttons on the left-hand side. From the Discussion Screen, you can: Insert, Replace, Delete, Back. You may or may not be able to perform all of these actions, depending upon what the Project Organizer has permitted you to use.

Insert This allows you to add to the comments on the screen.
Replace This allows you to replace an existing comment. This can be made unavailable to some users through the Options command.
Delete This allows you to delete a comment that is no longer useful. This can be made unavailable to some users through the Options command.
Back This allows you to go back to the Topic Screen to choose a new Topic, when you are finished with the current Topic.

Voting - This allows you to vote on Topics and to modify the appearance and criteria used in the voting procedure. When you first enter the Voting Screen, you will see the Project name at the top followed by a box with a list of Topics as well as some criteria.

Vote To vote from this screen you will need to:

1. Click on the ratings box so that a cursor appears. Type in the number that you wish to rate the
topic (make sure that it is an integer -- no decimals permitted). You can use the mouse or the Tab key to move among the boxes.

2. Click on the *Enter* button.

Enter This records the numbers you have entered. Until you press enter, your vote is not recorded in the group averages. Once Enter is pressed, the changes that you have made are permanent and the old numbers will be erased. When you are sure that the numbers are to your liking, click on Enter and the change will be made.

Group This allows you to see the average ratings for the entire group.

Options The Vote Options Screen allows you to change the names and ranges of the Criteria as well as the format of the boxes.

Order This allows you to change the order of Topics on the Voting Screen and Group ratings screen.

Back This allows you to go back to the Topic Screen to choose a new Topic, when you are finished with the current Topic.

You may or may not be able to perform all of these actions, depending upon what the Project Organizer has permitted you to use.

Only one vote is permitted for each user-name. If more than one person is using the same user-name, the votes will not be calculated correctly.

All topics are displayed in the same order as order they appear on the topic screen. To change the order, click Order.

7.9.2 TWISTER Guide for Students

TWISTER
Student's Guide
URL: http://128.192.24.154/~aimhigh/twister/twister.htm

TWISTER Home Page

Home Brings you to the home page. Note: if you select Home after you have entered TCBWorks, it will automatically log you out of TCBWorks.
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Documents - This provides access to document resources. These might syllabi, student papers, past discussions, or other project related materials. If there is a document that needs to be posted please contact Lara Luetkehans, luetke@coe.uga.edu, the TWISTER administrator.

TCBWorks - There are *Excel*lent help screens available within TCBWorks; please use them. They will be especially helpful for detailed information. The following are quick tips for the features available to you.

TCBWorks entry screen

Folder Name: (must be in all caps)
Your Name: (first 18 characters; lower case)
Password: (last four digits of your social security number)

TCBWorks Projects - In the 'EIT729' folder there are several projects listed.

Open This will open the project and take you to the Topic Screen for that Project.
View This allows you to see a list of all of the topics and comments that are in the Project.
Add This allows you to add new projects for discussion.
Refresh TCBWorks does not automatically update your screen whenever a Project, Topic, or Comment is added, deleted, or changed. This means if you are on a screen and someone else adds something new to TCBWorks, you will not see that new entry. Refresh reloads the page and checks for new entries. Every so often you will need to click on the Refresh button to see if anything new has been added. Refresh is performed automatically any time you perform any action (e.g., add, delete).
Logout This allows you to exit from TCBWorks, but not from TWISTER.

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Vote This allows you to vote on Topics within a Project. See Voting (below or in TCBWorks' online help) for more information.
View This allows you to a list of all of the Topics and Comments in the Project.
Back This allows you to go back to the Project Screen to choose a new Project or to Logout from the system.

Comments - From the Discussion Screen, you can read and write comments on a particular topic. The Topic is listed at the top of the screen. The comments are next and are listed in numerical order. At the bottom of the screen is the input box with the Action buttons on the left-hand side. From the Discussion Screen, you can: Insert, Replace, Delete, Back. You may or may not be able to perform all of these actions, depending upon what the Project Organizer has permitted you to use.

Insert This allows you to add to the comments on the screen.
Back This allows you to go back to the Topic Screen to choose a new Topic, when you are finished with the current Topic.

Voting - This allows you to vote on Topics and to modify the appearance and criteria used in them voting procedure. When you first enter the Voting Screen, you will see the Project name at the top followed by a box with a list of Topics as well as some criteria.

Vote To vote from this screen you will need to:
1. Click on the ratings box so that a cursor appears. Type in the number that you wish to rate the
topic (make sure that it is an integer – no decimals permitted). You can use the mouse or the Tab key to move among the boxes.
2. Click on the *Enter* button.

Enter This records the numbers you have entered. Until you press enter, your vote is not recorded in the group averages. Once Enter is pressed, the changes that you have made are permanent and the old numbers will be erased. When you are sure that the numbers are to your liking, click on Enter and the change will be made.

Group This allows you to see the average ratings for the entire group.

Back This allows you to go back to the Topic Screen to choose a new Topic, when you are finished with the current Topic.

You may or may not be able to perform all of these actions, depending upon what the Project Organizer has permitted you to use. Only one vote is permitted for each user-name. If more than one person is using the same

user-name, the votes will not be calculated correctly. All topics are displayed in the same order as order they appear on the topic screen. To change the order, click Order.

7.10 Glossary

analog communication
A communication format in which information is transmitted by modulating a continuous signal, such as a radio wave. Voice and video messages originate in analog form since sound and light are wave-like functions. Thus, they must be converted into digital messages in order to communicate along digital communications formats or media. (See also digital communication.)

Association for Education Communication and Technology (AECT)
An organization devoted to promoting educational technology activities, interaction, and professional development. It has eleven divisions devoted to special interests.

asynchronous communication
A method of sending and receiving information broken into small packets; messages sent to someone asynchronously are meant to be read at the receiver's convenience.

backbone
The main communication channel in a network wiring scheme, so called because often other communications lines connect to it like ribs connect to backbone. (See also network.)

bandwidth
The difference between the highest and lowest frequencies available for a network signal. A measure of information-carrying capability of a transmission wire; the range of transmission frequency that a network can use. Wider bandwidths can carry more information.

bookmark
A feature of WWW browsers and Gopher client applications that permit identification of favorite or important locations by the end user.

browser
A software application that allows users to use the Internet service such as the World Wide Web.

chat room
Public or private area on a computer network where members type messages and receive immediate responses.

client
A computer that can request and receive services, information, and applications, including file transfer from a server computer.

client software

A software program that is used to contact and obtain data from a server software program on another computer. Usually each client program is designed to work with specific kinds of server programs. (See also Server.)

computer conference
In computer networking, a conference is an online discussion group established by topic.

computer mediated communication (CMC)
One of many terms used to describe communications through electronic exchanges; sometimes referred to as telecomputing or educational telecommunications.

connectivity
Usually refers to a degree or level in which one computer can interact with another computer or an online service. Lower-connectivity usually supports only the exchange of email, while a more advanced level connectivity may support FTP, Telnet, and World Wide Web services.

digital communications
A communications format used with both electronic and light-based systems that transmits audio, video, and data as discrete bits of information.

distance learning
A learning environment where participants are separated by space and/or time and communication and interaction are technologically mediated.

distributed network
A network that relies on multiple computers to provide various resources to other computers in the network. The Internet depends on distributed networking.

download
To copy a file, email, or other information from a server to a client. (See also upload.)

electronic mail (email)
A network application for exchanging mail messages (usually text) over various types of networks using various network protocols. Messages can be addressed to an individual, as well as to large numbers of people. (See also mailing lists.)

fiber optic cable
Very thin, flexible glass rods that use light signals to transmit information. Fiber-optic cable has much higher capacity than copper or coaxial cable, and is resistant to interference or noise. Fiber-optic cable has the bandwidth to accommodate high-speed, multimedia networking.

file server
The computer that provides access to files for all computers in a local area network.

gateway

A dedicated computer that provides a link between separate networks, allowing information to pass between them.

groupware
A software program that supports the simultaneous or asynchronous sharing of information among a group of computers. Groupware may allow users to communicate with each other or to edit text and graphics in a single document from their individual computers.

home page
The first or main page of a site, organization, or other entity on the World Wide Web. Home pages are often linked to other pages.

HTML (Hypertext Markup Language)
A set of codes placed in documents so they can be displayed on the World Wide Web.

HTTP (Hypertext Transfer Protocol)
The protocol used to transport hypertext documents across the Internet; HTTP protocol is used in the World Wide Web.

hyperlink
An electronic connection between a word or image that appears at one location to information that is stored at another location.

hypertext
A system for linking documents in a nonlinear way. Words in the document can be linked to other documents or to parts of the same document. On World Wide Web pages, the highlighted words are linked to other pages. Users can either read the Web-page serially, or 'jump' from one page to another without typing special commands, but by simply pressing on the highlighted ("hot") word.

IRC (Internet Relay Chat)
Synchronous (in real time) chat using communication with computer keyboard (no voice or video). These chats are often focused on specific topics.

Internet
A worldwide collection of interconnected electronic networks that support a common set of data communication protocols: Transmission Control Protocol (TCP) and Internet Protocol (IP). The Internet evolved from ARPAnet.

ISDN (Integrated Service Digital Network)
Network that accommodates digital transmission of voice, data, and video over standard copper telephone lines. It can provide data transfers at speeds of 64,000 BPS at almost the same cost as a normal phone call. Basically, it is a regular copper-wire telephone line that has been tweaked to transmit voice or data using digital instead of analog signals.

IUPUI
Indiana University/Purdue University at Indianapolis

job aid
A tool developed to support learners in practicing a new task or set of skills.

listserv
A specific automatic mailing program that can run on any Internet server. It distributes email to users who share common interests and whose Ids are stored together. Any mail sent to a list on the listserv is automatically distributed to everyone on that list.

local area network (LAN)
A network linking computers in close proximity; LANs facilitate communication and sharing of computer resources, such as printers or storage drives.

login
Noun: the account name used to access a computer system.
Verb: the act of entering and leaving an electronic communications system; access generally requires also a secret password.

mailbox
A file or directory on a user's host computer that holds the user's email.

mailing list
A system that allows the sending of topic-specific email to multiple mail destinations.

network
A shared communications system that supports digital communication among connected computers.

network Administrator
The person who helps maintain a network.

newsgroup
A topical discussion group located on a network. Individuals submit messages to a newsgroup and read messages that are posted there.

online
Being actively connected to a network or computer system; usually being able to interactively exchange data, commands, and information.

Project Coordinator
Dr. Ted Lamb.

router

A device (sometimes a specialized computer) that stores addresses of network hosts and forwards packets of data between networks. In order to access the Internet's resources, a local-area-network needs its own router. Routers spend all their time looking at the destination addresses of the packets passing through them and deciding on which route to use to forward them.

search engine
A type of software that facilitates locating files and information based on keywords and descriptors.

server
A computer that provides a specific kind of service to client software running on other computers. The term can refer to a particular piece of software, such as a WWW server. (See also Client.)

synchronous communication
Interaction, via electronic means, at the same time (in real time).

telecommunications
The transfer of information or messages at a distance, using electricity and electromagnetism.

teleconference
Simultaneous visual and/or sound connections using telecommunications links that allow individuals in remote locations to see and communicate with each other in a conference arrangement. There are many types of teleconferencing, including video-conferencing, computer conferencing, and audio-conferencing.

TWISTER
The Web-based groupware tool created by project investigators specifically for the educational purposes of USAFA.

UGA
University of Georgia.

URL
The acronym for Uniform Resource Locator; an electronic address on the World Wide Web.

USAFA
United States Air Force Academy.

USAFANet
The computer network at USAFA.

video-conferencing